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FRANCK-CONDON FACTORS FOR VARIOUS AIR SPECIES

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TECHNICAL REPORT NO. AFWL-TR-70-108

AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base
New Mexico

January 1971

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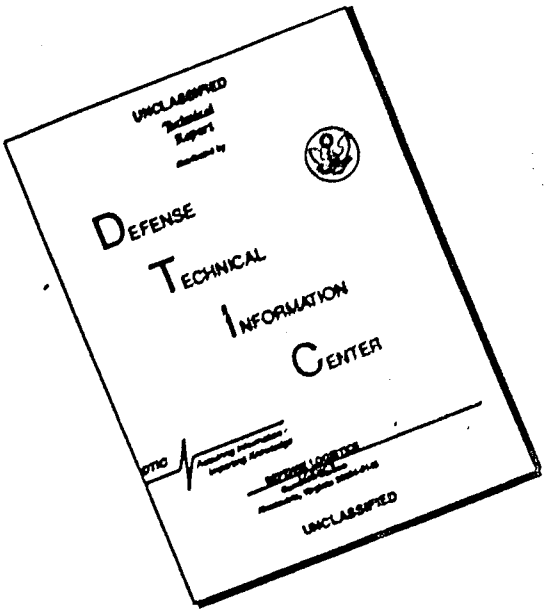

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FOREWORD

This research was performed under Program Element 61102H, Project 5710, Subtask HC 061, and was funded by the Defense Atomic Support Agency (DASA).

Inclusive dates of research were July 1967 through September 1968. The report was submitted 27 November 1970 by the Air Force Weapons Laboratory Project Officer, Captain Richard Harris (SYT).

This technical report has been reviewed and is approved.

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ABSTRACT

(Distribution Limitation Statement No. 3)

In the process of calculating opacities which are needed as input data for radiation transport problems, the absorption cross sections for various species has to be known. One factor in the cross section is the vibrational transition probability, called the Franck-Condon factor (FCF). This report presents input data needed to calculate these from Rydberg-Klein potentials as well as tables of Franck-Condon factors for species of atmospheric interest.

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LIST OF VARIABLES

B_e	rotational constant in the equilibrium position
B_i	rotational constant used by Vanderslice for the i^{th} level determined by least squares fit
B_v	rotational constant for the v^{th} vibrational level
B_v^{eff}	effective rotational constant for the v vibrational level
D_e	dissociation energy of the electronic state of the molecule
dt	volume element
E(I,K)	vibrational-rotational energy of a molecule in terms of continuous classical variables, I,K
E(v,J)	vibrational-rotational energy of a molecule in terms of vibrational and rotational quantum numbers
E_R	rotational energy of a molecule
E_v	vibrational energy of a molecule
f	a Klein action integral: $\partial S/\partial U$
g	a Klein action integral: $-\partial S/\partial K$
G_v	vibrational term
$\Delta G_{v+\frac{1}{2}}$	separation of successive vibrational terms
$\hat{H}$	Hamiltonian operator
I	classical action integral, when quantized it is set equal to $h(v+\frac{1}{2})$
I'	the value of I such that U = E(I,K)
J	rotational quantum number
K	related to classical angular momentum
l	classical angular momentum
m	mass
O_p	a general operator of quantum mechanics
p_r	linear momentum along r (internuclear separation) axis
$q_{v'v''}$	Franck-Condon factor
r	internuclear separation of molecule

LIST OF VARIABLES (cont'd)

r_e	internuclear separation at equilibrium
r_{max}	larger of the two classical turning points
r_{min}	smaller of the two classical turning points
$r_{v'v''}$	r centroid
$r^2_{v'v''}$	r^2 centroid
S(U,K)	Klein's auxiliary function
τ	total transition probability
T_e	relative energy of separation between the minimums of two electronic states
U	total vibrational-rotational energy of a molecule
U_i	energy of the i^{th} level in Vanderslice's formulation
v	vibrational quantum number
V(r)	rotationless vibrational potential of a molecule
V_{eff}	rotationless vibrational potential corrected for centrifugal effects
w_i	parameter in Vanderslice's formulation
α_e	rotational constant
γ_e	rotational constant
δ_e	rotational constant
ε_e	rotational constant
μ	reduced mass of molecule
ψ_f	final total wave function
ψ_i	initial total wave function
ψ_{fe}	final electronic wave function
ψ_{ie}	initial electronic wave function
ψ_{fR}	final rotational wave function
ψ_{iR}	initial rotational wave function
ψ_{fv}	final vibrational wave function

LIST OF VARIABLES (cont'd)

ψ_{iv}	initial vibrational wave function
$\psi_{v''}$	vibrational wave function for lower state
$\psi_{v'}$	vibrational wave function for upper state
t_v	period of vibration of molecule
w_e	vibrational constant
wexe	vibrational constant
weye	vibational constant
weze	vibrational constant
wete	vibrational constant
wi	vibrational constant in Vanderslice's formulation determined from least squares fit
wixi	vibrational constant in Vanderslice's formulation determined from least squares fit

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SECTION I

INTRODUCTION

For any given fixed temperature, the intensity distribution of the spectrum of a band system in a typical atmospheric diatomic molecule is determined primarily by the vibrational transition probability. The intensity distribution within a vibrational band is determined by the rotational transition probability. This report will be concerned with only the calculation of the vibrational transition probabilities called the Franck-Condon factors. These are defined by the following overlap integral:

$$q_{v'v''} = \left(\int \psi_{v'} \, \psi_{v''} \, dr \right)^2 \tag{1}$$

where $\psi_{v'}$, $\psi_{v''}$ are the vibrational wave functions to be described in detail later and v', v'' refer to the upper and lower vibrational quantum number, respectively. The Franck-Condon factors satisfy the following relations:

$$\text{all} \sum_{v'} q_{v'v''} = 1$$

and

$$\text{all} \sum_{v''} q_{v'v''} = 1 \tag{2}$$

Since the overlap integral involves the vibrational wavefunctions of the initial and final states of the molecule, the Schrodinger equation must be solved for these wavefunctions.

$$\hat{H} \, \psi_v = E_v \, \psi_v \tag{3}$$

where

ψ_v is the vibrational wavefunction of level v

E_v is the energy of vibrational level v

$\hat{H}$ is the Hamiltonian operator for the problem

The Hamiltonian operator contains a term for the potential energy in which the two nuclei move. The correctness of this potential will determine how good the vibrational wavefunctions will be. This in turn determines the accuracy of the Franck-Condon factors. Hence the better the potential the better the Franck-Condon factors.

There have been a great many empirical potential energy functions developed over the past few decades. A study of these and the relative merits of each has been done by Steele et al. (Ref. 1).

Among the most popular potentials in the past for calculating Franck-Condon factors has been the Morse potential.

$$V(r) = De\left[1 - e^{-ax}\right]^2 \qquad (4)$$

where

$$a = \left\{\frac{4\pi^2 c^2 \omega e^2 \mu}{2De}\right\}^{\frac{1}{2}}$$

De is the dissociation energy

$x = (r - re)$

re is the internuclear separation at the minimum of the potential well

r is the internuclear separation

Using this potential one can develop a closed form representation for the wavefunctions, hence the evaluation of the overlap integrals can be done without the need of a large computer. However, this potential is accurate only near the bottom of the potential well. Therefore the Franck-Condon factors for the upper vibration levels may be inaccurate.

To calculate better wavefunctions for the upper vibrational levels, one needs a better potential. One such method for calculation a better potential has been developed by Rydberg (Ref. 2) and Klein (Ref. 3), which makes use of experimentally measured data. Subsequently, it has been modified in various ways by other investigators, notably by Rees (Ref. 4). The general method has become known as the Rydberg-Klein-Rees or R-K-R method. In many instances this is a misnomer because the Rees modification is not even used.

The method is based on a WKB approximation and will be outlined below. This treatment of the basic equations is based on the derivation in a paper by Vanderslice et al. (Ref. 5).

Rydberg used two expressions from classical mechanics and modified them appropriately to obtain the corresponding quantum mechanical expressions. The classical equations for the action integral is

$$\int p_r \, dr = (2\mu)^{\frac{1}{2}} \int \left[\tilde{U} - \tilde{V}_{eff}\right]^{\frac{1}{2}} dr \qquad (5)$$

where

p_r is the momentum in r direction

r is the internuclear separation

μ is the reduced mass of the molecule

$\tilde{V}_{eff}$ is the effective potential

$\tilde{U}$ is the total vibrational-rotational energy given by

$$\tilde{U} = \frac{\left(P_r\right)^2}{2\mu} + \frac{\ell^2}{2\mu r^2} + \tilde{V}(r) \qquad (6)$$

where

ℓ is the angular momentum of the rotating molecule

$\tilde{V}(r)$ is the potential energy of the rotationless molecule

Letting

$$K = \frac{\ell^2}{2\mu}$$

one then has

$$\tilde{U} = \frac{\left(P_r\right)^2}{2\mu} + \frac{K}{r^2} + \tilde{V}(r)$$

or

$$\tilde{U} = \frac{P_r^2}{2\mu} + \tilde{V}_{eff} \qquad (7)$$

where

$$\tilde{V}_{eff} = \frac{K}{r^2} + \tilde{V}(r)$$

from which follows equation (7) after solving the P_r and substituting this expression in the action integral.

The action integral equation (17) is quantized as if it were a harmonic oscillator which results in the equation

$$h(v+\tfrac{1}{2}) = (2\mu)^{\frac{1}{2}} \int \left[\tilde{U} - \tilde{V}_{eff}\right]^{\frac{1}{2}} dr \qquad (8)$$

This is the first basic equation of Rydberg's method.

The second basic equation of Rydberg involves the rotational energy of the system. Again, classically this is given by

$$\tilde{E}_r = K\left(\frac{1}{r^2}\right)_v = \frac{K}{\tau_v} \int \left(\frac{1}{r^2}\right) dt = \frac{K\mu}{\tau_v} \int \frac{1}{r^2 P_r} dr \qquad (9)$$

where

K is the same as for equation (7)

τ_v is the period of vibration

Quantization of K the rotational angular momentum leads to

$$K = \frac{h^2}{8\pi^2\mu} J(J+1) \qquad (10)$$

with which the rotational energy integral becomes, upon solving equation (15) for P_r and substituting this in equation (17),

$$\frac{h^2}{8\pi^2\tau} \frac{1}{\sqrt{2\mu}} \int \left[\tilde{U} - \tilde{V}_{eff}\right]^{-\frac{1}{2}} \frac{dr}{r^2} = \frac{h^2}{8\pi^2\mu}\left(\frac{1}{r^2}\right)_v = B_v \qquad (11)$$

This is Rydberg's second basic equation. Rydberg solved these graphically. The second of these becomes infinite at the classical turning points since $\tilde{U} = \tilde{V}_{eff}$ there. This increases the difficulty of solving the problem graphically since large errors can be made in the regions of the classical turning points.

Klein defined a new function $S(\tilde{U},K)$ to aid in finding the classical turning points, given by

$$S(\tilde{U},K) = \frac{1}{(2\pi^2\nu)^{\frac{1}{2}}} \int_0^{I'} \left[\tilde{U} - \tilde{E}(I,K)\right]^{\frac{1}{2}} dI \qquad (12)$$

where

$I = h(v+\frac{1}{2})$

$\tilde{U}$ is the total energy

$K = \frac{\ell^2}{2\mu}$

$\tilde{E}(I,K)$ is the vibrational-rotational energy

I' is the value of I such that $\tilde{U} = \tilde{E}(I,K)$

Using this function Klein found that expressions for the classical turning points were given by

$$\frac{\partial S}{\partial \tilde{U}} = f = \tfrac{1}{2}\left(r_{max} - r_{min}\right) \qquad (13)$$

and

$$-\frac{\partial S}{\partial \tilde{K}} = g = \tfrac{1}{2}\left(\frac{1}{r_{min}} - \frac{1}{r_{max}}\right) \qquad (14)$$

which can be inverted to give

$$r_{min} = \left(\frac{f}{g} + f^2\right) - f \qquad (15)$$

$$r_{max} = \left(\frac{f}{g} + f^2\right) + f \qquad (16)$$

The integration and differentiation of Klein's equations must be carried out numerically in general. Before the large computers of recent years this presented a problem. Rees therefore made the next modification to the Rydberg-Klein method, by observing that the integral for $S(\tilde{U},K)$ could be integrated analytically if in the function $\tilde{E}(I,K)$, I is expressable as a quadratic (or cubic) form in $(v+\frac{1}{2})$. Consequently, f,g can be written in closed form.

Vanderslice et al. capitalized on this observation and have fitted the energy $\tilde{E}(I,K)$ with a series of quadratics over the whole energy range of the potential function. They then obtained a closed form representation for g,f

and consequently, r_{min} and r_{max}. Their expressions for g and f are

$$f = \left(\frac{h}{8\pi^2\mu c}\right)^{\frac{1}{2}} \sum_{i+n}^{n} (wx)^{-\frac{1}{2}} \ln W_i \tag{17}$$

$$g = \left(\frac{2\pi^2\mu c}{h}\right)^{\frac{1}{2}} \sum_{i=1}^{n} \left[\tfrac{1}{4}\alpha_i (wx)_i^{-1} \left(U_i^{\frac{1}{2}} - U_{i-1}^{\frac{1}{2}}\right)\right.$$

$$\left. + (wx)_i^{-\frac{1}{2}} \left(2B_i - \alpha_i (wx)_i^{-1} W_i\right) \ln W_i\right] \tag{18}$$

where

$$W_i = \left[\frac{W_i^2 - 4(wx)_i U_i}{W_i^2 - 4(wx)_i U_{i-1}}\right]^{\frac{1}{2}} \left[\frac{W_i - 2(wx)_i^{\frac{1}{2}} U_{i-1}^{\frac{1}{2}}}{W_i - 2(wx)_i^{\frac{1}{2}} U_i^{\frac{1}{2}}}\right] \tag{19}$$

W_i is the coefficient of $(v+\frac{1}{2})$

wx_i is the coefficient of $(v+\frac{1}{2})^2$

α_i is the coefficient of $(v+\frac{1}{2})$ J(J+1) (coupling constant)

β_i is the coefficient of J(J+1)

Vanderslice et al. also give a simple interpretation of the $S(\tilde{U},K)$ function of Klein. $S(\tilde{U},K)$ is one half the area between the constant total energy curve, $\tilde{U}$, and the potential curve $V_{eff}(r)$ (see figure 1).

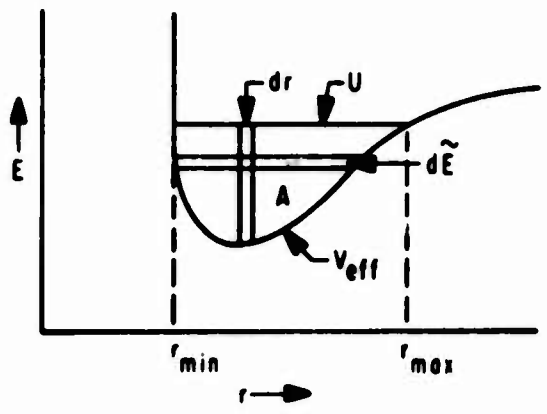

Figure 1. Interpretation of the Klein S Function

Following Vanderslice,

$$dI = \tau dE \tag{20}$$

with

$$\tau = \left(\frac{\mu}{2}\right)^{\frac{1}{2}} \int \left(E - V_{eff}\right)^{-\frac{1}{2}} dr \tag{21}$$

putting τdE in for dI in Klein's equation for S,

$$S(\tilde{U},K) = \frac{1}{(2\pi^2\mu)^{\frac{1}{2}}} \int_0^I \left[\tilde{U} - \tilde{E}(I,K)\right]^{\frac{1}{2}} dI$$

one finds,

$$S = \frac{1}{2\pi} \int_0^U (\tilde{U} - \tilde{E})^{\frac{1}{2}} \left[\left(\tilde{E} - \tilde{V}_{eff}\right)^{-\frac{1}{2}} dr\right] d\tilde{E}$$

or

$$S = \frac{1}{2\pi} dr \int_{V_{eff}}^U (\tilde{U} - \tilde{E})^{\frac{1}{2}} \left(\tilde{E} - \tilde{V}_{eff}\right)^{\frac{1}{2}} d\tilde{E} \tag{22}$$

The lower limit of the second integral is V_{eff} since it is evaluated at a constant value of r.

The last integral becomes, after some manipulation,

$$S = \frac{1}{2} \int_{r_{min}}^{r_{max}} dr \int_{V_{eff}}^U dE = \frac{1}{2} A \tag{23}$$

1. METHODS OF VARIOUS INVESTIGATORS

Many investigators have reported calculating RKR potentials for molecules of importance in heated air. Table 1 contains the name of the investigator (or investigators) and the general method used.

Table 1

INVESTIGATORS USING A WKB-TYPE APPROXIMATION

Name	Method
Flinn, Spindler, Fifer	RKR
Gilmore	RK, KDJ
Ginter, Battino	RKR
Halmann, Laulicht	RK
Jarmain	KDJ
Jain, Shani, Singh	RKR
Krupenie, Weissman	RK
Richards, Barrow	RK-RKR (hybrid)
*Vanderslice et al.	RKR
Zare, Albritton	RK
AFWL	RK

The RK method uses Klein's equations and numerically integrates them in some fashion. The RKR method uses the quadratic fit of Rees in some fashion. The KDJ method makes use of a series developed by Jarmain (Ref. 6) based on a series expansion of a WKB approximation by Dunham (Ref. 7). With some simplifying approximations this expansion is the same as a series expansion of Klein's equations, which are also based on a WKB approximation. Hurley (Ref. 8) has shown the two methods are equivalent and can be deduced from the same basic equation.

2. LIMITATIONS OF RK OR RKR METHODS

Ginter and Battino (Ref. 9) have discussed the effects of experimental errors and errors due to approximations made in the formulation of equations used in the RKR methods on the calculated potential curves. A summary of their conclusions will be presented.

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*Co-author with several people on different papers.

The accuracy with which one can represent the vibrational-rotational energy levels of an electronic state of a diatomic molecule by a polynomial E(v,J) primarily determines the accuracy of the calculated potential. The errors in determining E(v,J) fall into three categories:

(1) Experimental error in spectroscopic data

(2) Error caused by fitting the best polynomial E(v,J) to the spectroscopic data

(3) Error caused by fitting the spectroscopic data to a particular form of E(v,J)

From (1) there can be errors because of uncertainty in determining B_v^{eff} and ΔG and errors due to using the effective constants directly. From (2) often times the experimental data will fit with any one of several expansions and do it equally well. From (3) if a series of expansions of quadratic form for E(v,J) is assumed, then errors may be introduced because of the fitting of local fluctuations in the experimental data.

3. ZARE PROGRAM AT AFWL

Several years ago R. N. Zare made available to the Air Force Weapons Laboratory (AFWL) a set of computer programs needed to construct R-K molecular potentials for diatomic molecules and to calculate Franck-Condon factors, r-centroids, and relative intensities from these potentials. A summary of the methods of the programs will be given.

The molecular potential generation program is one which was written by J. Kasper (Ref. 10). The equations,

$$f = \frac{h}{2\pi(2\mu)^{\frac{1}{2}}} \int_0^{I'} \left[U - E(I,K)\right]^{-\frac{1}{2}} dI \qquad (24)$$

$$g = \frac{h}{2\pi(2\mu)^{\frac{1}{2}}} \int_0^{I'} B_v \left[U - E(I,K)\right]^{-\frac{1}{2}} dI \qquad (25)$$

are integrated directly without assuming an analytic form for the integral near the upper limit.

For the energy E(I,K) of the level of interest either the conventional expansion

$$E(v,J) = \omega_e(v+\tfrac{1}{2}) - \omega_e x_e(v+\tfrac{1}{2})^2 + \omega_e y_e(v+\tfrac{1}{2})^3$$

$$+ \omega_e z_e(v+\tfrac{1}{2})^4 + \omega_e t_e(v+\tfrac{1}{2})^5 + \ldots$$

$$+ B_v J(J+1) - D_v J^2(J+1)^2 + \ldots \qquad (26)$$

or the G_v, B_v obtained directly from the spectroscopic data can be used. The variables I,K are of course related to V,J by

$$I = h(v+\tfrac{1}{2}) \qquad (27)$$

$$K = \frac{h^2}{2\pi^2\mu} J(J+1) \qquad (28)$$

From the f,g the values of r_{min} and r_{max} are calculated for each vibrational level. These are then used as input data to the Franck-Condon factor program. To calculate the wavefunctions needed in the Franck-Condon factor program, the radial Schrodinger equation is solved (for the wavefunctions) by a numerical method developed by Cooley (Ref. 11). The one-dimensional second order Schrodinger equation,

$$\frac{d^2}{dr^2}\psi + \left[E(v,J) - V_{eff}(r,J)\right]\psi = 0 \qquad (29)$$

where

E(v,J) is the energy of the particular level,

$$V_{eff}(r,J) = V(r) + \frac{h^2}{8\pi\mu r^2} J(J+1) \qquad (30)$$

is the energy of rotationless level corrected for rotation, and ψ, the vibration-rotation wavefunction, is changed to a finite difference equation.

The finite difference equation is solved iteratively for E(v,J) the eigenvalue and ψ the eigenfunction, until the E(v,J) and the previous E(v,J) differ by an arbitrarily small amount. The wavefunctions thus obtained are used in the evaluation of the square of the overlap integral which is the Franck-Condon factor.

$$q_{v'v''} = \int \psi_{v'J'} \, \psi_{v''J''} \, dr^2 \tag{31}$$

They are also used in evaluating the r-centroids.

$$r_{v'v''} = \frac{\int \psi_{v'} \, r \, \psi_{v''} \, dr}{\int \psi_{v'} \, \psi_{v''} \, dr} \tag{32}$$

$$r^2_{v'v''} = \frac{\int \psi_{v'} \, r^2 \, \psi_{v''} \, dr}{\int \psi_{v'} \, \psi_{v''} \, dr} \tag{33}$$

The integrals are all evaluated using a Simpson's rule numerical integration procedure. The relative intensities scaled to ten are also calculated.

The programs provided by Dr. Zare have been adapted for use on the AFWL CDC 6600 computer. Since this computer carries 15 decimal numbers per word, the double precision subroutines were removed. The (v',v'') array size for the computed Franck-Condon factor was increased to (20,23). Some of the input statements were modified and output statements were added. Aside from these changes the program used at AFWL is the same as the one developed and used by Dr. Zare.

SECTION II

MOLECULAR BAND SYSTEMS CONSIDERED

The motivation for calculating Franck-Condon factors at AFWL is their use in calculating transition strengths of diatomic molecules. These strengths are used in part to calculate absorption coefficients which in turn are frequency averaged over prechosen frequency groups to give opacities for air. These opacities are desired over a large temperature density range. When determining which molecules are candidates for inclusion in the opacity calculation, one must take into account the chemistry that goes on in this heated air. After picking the potential molecules one looks at the various transitions allowed in the molecules and the relative strengths and positions (in energy) of the transitions. Then from these one arrives at a list of important electronic band systems of diatomic molecules in heated air.

The following table contains information on all transitions considered in the present work. The transition involved, common name of the band system, the source of the potential, and array size calculated are listed.

Table 2

TRANSITIONS INCLUDED

States involved	Name	Source of potential State Upper	Lower	Array size (v'v")
CN $B^2\Sigma^+$-CN $X^2\Sigma^+$	CN violet	13	13	(18,18)
CN $A^2\pi_{1/2}$-CN $X^2\Sigma^+$	CN red	13	13	(18,18)
CN $A^2\pi_{3/2}$-CN $X^2\Sigma^+$	CN red	13	13	(18,18)
CO $A^1\pi$-CO $X^1\Sigma^+$	CO 4th positive	16	16	(20,24)
N_2 $B^3\pi_g$-N_2 $A^3\Sigma_u^+$	1st positive	18	18	(17,13)
N_2 $C^3\pi_u$-N_2 $B^3\pi_g$	2nd positive	18	18	(4,17)
N_2 $b'^1\Sigma_u^+$-N_2 $X^1\Sigma_g^+$	Birge-Hopfield #1	33	19	(20,21)
N_2 $b'^1\pi_u$-N_2 $X^1\Sigma_g^+$	Birge-Hopfield #2	33	19	(24,21)

Table 2 (cont'd)

States involved	Name	Source of potential State Upper	Lower	Array size (v'v")
$N_2^+ A^2\pi_u$-$N_2^+ X^2\Sigma_g^+$	Meinel	33	33	(20,20)
$N_2^+ B^2\Sigma_u^+$-$N_2^+ X^2\Sigma_g^+$	1st negative	33	33	(20,20)
$N_2^+ C^2\Sigma_u^+$-$N_2^+ X^2\Sigma_g^+$	2nd negative	33	33	(10,20)
NO $A^2\Sigma^+$-NO $X^2\pi_{1/2}$	γ (gamma)	22	23	(5,23)
NO $A^2\Sigma^+$-NO $X^2\pi_{3/2}$	γ (gamma)	22	23	(5,23)
NO $B^2\pi$-NO $X^2\pi_{1/2}$	β (beta)	22	23	(19,23)
NO $B^2\pi$-NO $X^2\pi_{3/2}$	β (beta)	22	23	(19,23)
NO $C^2\pi$-NO $X^2\pi_{1/2}$	δ (delta)	22	23	(4,23)
NO $C^2\pi$-NO $X^2\pi_{3/2}$	δ (delta)	22	23	(4,23)
NO $D^2\Sigma^+$-NO $X^2\pi_{1/2}$	ε (epsilon)	33	23	(7,23)
NO $D^2\Sigma^+$-NO $X^2\pi_{3/2}$	ε (epsilon)	33	23	(7,23)
NO $B'^2\Delta_i$-NO $X^2\pi_{1/2}$	β' (beta prime)	22	23	(5,23)
NO $B'^2\Delta_i$-NO $X^2\pi_{3/2}$	β' (beta prime)	22	23	(5,23)
NO $E^2\Sigma^+$-NO $X^2\pi_{1/2}$	γ' (gamma prime)	22	23	(5,23)
NO $E^2\Sigma^+$-NO $X^2\pi_{3/2}$	γ' (gamma prime)	22		(5,23)
NO $G^2\Sigma$-NO $X^2\pi_{1/2}$	Lagergmist-Miescher	33	23	(7,23)
NO $C^2\pi$-NO $A^2\Sigma^+$	Heath	22	22	(4,5)
NO $D^2\Sigma^+$-NO $A^2\Sigma^+$	Feast 1	22	22	(7,5)
NO $E^2\Sigma^+$-NO $A^2\Sigma^+$	Feast 2	22	22	(5,5)
NO $E^2\Sigma^+$-NO $C^2\pi$		22	22	(5,4)
NO $E^2\Sigma^+$-NO $D^2\Sigma^+$	Feast-Heath	22	33	(5,7)
O_2 $B^3\Sigma_u^-$-O_2 $X^3\Sigma_g^-$	Schumann-Runge	33	33	(20,23)
	N_2-N_2^+			
N_2 $X^1\Sigma_g^+$-N_2^+ $X^2\Sigma_g^+$	1st	33	33	(20,20)

Table 2 (cont'd)

States involved	Name	Source of potential State Upper	Lower	Array size (v'v")
N_2 $X^1\Sigma_g^+$-N_2^+ $A^2\pi_u$	2nd	33	33	(20,20)
N_2 $X^1\Sigma_g^+$-N_2^+ $B^2\Sigma_u^+$	3rd	33	33	(20,20)
N_2 $X^1\Sigma_g^+$-N_2^+ $C^2\Sigma_u^+$	4th	33	33	(10,20)
	O_2-O_2^+			
O_2 $X^3\Sigma_g^-$-O_2^+ $X^2\pi_g$	1st	33	33	(14,23)
O_2 $X^3\Sigma_g^-$-O_2^+ $a^4\pi_u$	2nd	33	33	(10,23)
O_2 $X^3\Sigma_g^-$-O_2^+ $A^2\pi_u$	3rd	33	33	(10,23)
O_2 $X^3\Sigma_g^-$-O_2^+ $b^4\Sigma_g^-$	4th	33	33	(10,23)
O_2 $X^3\Sigma_g^-$-O_2^+ $^2\Sigma_g^-$	5th	33	33	(10,23)
O_2 $X^3\Sigma_g^-$-O_2^+ $c^4\Sigma_u^-$	6th	33	33	(10,23)

1. CN (CYANOGEN) BAND SYSTEMS

The potentials used to calculate Franck-Condon factors were taken from the paper by Fallon, Vanderslice, and Cloney (Ref. 13). Tables 3 through 6 contain the data for the potential energy curves for the various CN states used. Table 7 contains other molecular data needed by the FRANKON program.

Table 3*

POTENTIAL ENERGY FOR THE CN $X^2\Sigma^+$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	1031.1	1.1237	1.2244	0.1278
1	3073.6	1.0923	1.1676	0.3811
2	5089.7	1.0722	1.2997	0.6310
3	7079.5	1.0566	1.3274	0.8777
4	9042.8	1.0438	1.3525	1.1211
5	10980.0	1.0327	1.3760	1.3613
6	12890.0	1.0230	1.3984	1.5981

Table 3* (cont'd)

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
7	14775.0	1.0143	1.4198	1.8317
8	16632.0	1.0063	1.4406	2.0620
9	18463.0	0.9991	1.4610	2.2890
10	20267.0	0.9924	1.4809	2.5127
11	22045.0	0.9861	1.5005	2.7330
12	23797.0	0.9803	1.5200	2.0503
13	25520.0	0.9749	1.5393	3.1639
14	27217.0	0.9696	1.5583	3.3743
15	28887.0	0.9648	1.5774	3.5813
16	30530.0	0.9602	1.5964	3.7850
17	32146.0	0.9558	1.6153	3.9853
18	33734.0	0.9516	1.6343	4.1823

*Reference 13.

Table 4*

POTENTIAL ENERGY FOR THE CN $A^2\pi_{3/2}$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	903.99	1.1827	1.2900	0.1121
1	2691.1	1.1482	1.3354	0.3336
2	4452.9	1.1269	1.3701	0.5521
3	6189.4	1.1105	1.4001	0.7673
4	7900.4	1.0969	1.4273	0.9795
5	9585.0	1.0852	1.4529	1.1884
6	11245.0	1.0749	1.4773	1.3942
7	12880.0	1.0657	1.5007	1.5968

Table 4* (cont'd)

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
8	14487.0	1.0573	1.5236	1.7960
9	16070.0	1.0477	1.5459	1.9923
10	17627.0	1.0526	1.5679	2.1853
11	19158.0	1.0360	1.5896	2.3751
12	20663.0	1.0298	1.6111	2.5617
13	22142.0	1.0240	1.6325	2.7451
14	23594.0	1.0186	1.6538	2.9254
15	25021.0	1.0134	1.6750	3.1020
16	26422.0	1.0083	1.6960	3.2757
17	27795.0	1.0038	1.7175	3.4460
18	29142.0	0.9994	1.7388	3.6130

*Reference 13.

Table 5*

POTENTIAL ENERGY FOR THE CN $A^2\pi_{1/2}$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	903.99	1.1816	1.2891	0.1121
1	2691.1	1.1484	1.3356	0.3336
2	4452.9	1.1272	1.3704	0.5521
3	6189.4	1.1109	1.4006	0.7673
4	7900.4	1.0975	1.4280	0.9795
5	9585.9	1.0860	1.4527	1.1884
6	11245.0	1.0759	1.4783	1.3942
7	12880.0	1.0668	1.5019	1.5968
8	14487.0	1.0587	1.5249	1.7960
9	16070.0	1.0512	1.5475	1.9923

Table 5* (cont'd)

v	V(cm^{-1})	r_{min}	r_{max}	V(ev)
10	17627.0	1.0443	1.5696	2.1853
11	19158.0	1.0379	1.4916	2.3751
12	20663.0	1.0319	1.6133	2.5617
13	22142.0	1.0263	1.6348	2.7451
14	23594.0	1.0211	1.6563	2.9254
15	25021.0	1.0161	1.6778	3.1020
16	26422.0	1.0115	1.6992	3.2757
17	27795.0	1.0070	1.7207	3.4460
18	29142.0	1.0028	1.7423	3.6130

*Reference 13.

Table 6*

POTENTIAL ENERGY FOR THE CN $B^2\Sigma^+$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	V(ev)
0	1077.0	1.104	1.203	0.1335
1	3200.0	1.074	1.246	0.3968
2	5284.0	1.055	1.279	0.6551
3	7325.0	1.040	1.307	0.9081
4	9321.0	1.027	1.333	1.1556
5	11269.0	1.016	1.358	1.3971
6	13167.0	1.007	1.383	1.6324
7	15011.0	0.999	1.407	1.8611
8	16799.0	0.992	1.432	2.0827
9	18527.0	0.986	1.457	2.2969
10	20192.0	0.980	1.483	2.5034

Table 6* (cont'd)

v	V(cm^{-1})	r_{min}	r_{max}	$V_{(ev)}$
11	21795.0	0.974	1.509	2.7021
12	23338.0	0.970	1.535	2.8933
13	24821.0	0.965	1.562	3.0773
14	26249.0	0.961	1.589	3.2542
15	27623.0	0.957	1.617	3.4247
16	28948.0	0.953	1.644	3.5889
17	30228.0	0.950	1.672	3.7475
18	31464.0	0.946	1.701	3.9008

*Reference 13.

Table 7

ADDITIONAL DATA NEEDED FOR THE CN MOLECULE

State	De	Be	αe	γe	Te
$X^2\Sigma^+$	61525.88	1.8996	0.01735	0	0.0
$A^2\pi_{3/2}$	52279.86	1.7165	0.01746	0	9222.04
$A^2\pi_{1/2}$	52279.86	1.7165	0.01746	0	9272.62
$B^2\Sigma^+$	54774.34	1.9701	0.02215	0	25752.4

2. CO (CARBON MONOXIDE) BAND SYSTEMS

The only band of CO considered to be of possible importance in absorption in heated air is the CO 4th positive system. The potentials used in calculating the Franck-Condon factors were taken from the paper by Krupenie and Weisman (Ref. 16). Tables 8 and 9 contain the data for the potential curves of the lower and upper states. Table 10 contains other molecular data needed by the program.

Table 8*

POTENTIAL ENERGY FOR THE CO $X^1\Sigma^+$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	1081.590	1.083	1.179	0.1341
1	3224.864	1.053	1.220	0.3998
2	5341.654	1.034	1.250	0.6623
3	7432.026	1.020	1.276	0.9214
4	9496.948	1.008	1.300	1.1773
5	11533.76	0.997	1.322	1.4300
6	13545.20	0.988	1.343	1.6794
7	15530.64	0.980	1.363	1.9255
8	17489.9	0.972	1.383	2.1684
9	19423.5	0.965	1.402	2.4081
10	21330.7	0.959	1.420	2.6446
11	23212.4	0.953	1.438	2.8779
12	25068.5	0.947	1.456	3.1080
13	26898.4	0.942	1.474	3.3349
14	28703.2	0.937	1.492	3.5587
15	30482.7	0.932	1.509	3.7793
16	32235.4	0.928	1.526	3.9966
17	33963.9	0.923	1.544	4.2109
18	35666.8	0.919	1.561	4.4220
19	37344.4	0.916	1.579	4.6300
20	38997.5	0.912	1.596	4.9349
21	40625.7	0.908	1.614	5.0368
22	42208.0	0.905	1.631	5.2330
23	43776.0	0.901	1.649	5.4274

*Reference 16.

Table 9*

POTENTIAL ENERGY FOR THE CO $A^2\pi$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	753.49	1.183	1.297	0.0934
1	2242.3	1.148	1.348	0.2780
2	3685.1	1.126	1.387	0.4569
3	5097.9	1.110	1.422	0.6320
4	6476.1	1.096	1.454	0.8029
5	7818.2	1.085	1.484	0.9693
6	9125.0	1.075	1.514	1.1313
7	10401.8	1.066	1.542	1.2896
8	11641.0	1.058	1.571	1.4433
9	12846.9	1.051	1.599	1.5928
10	14018.8	1.044	1.627	1.7381
11	15155.6	1.038	1.656	1.8790
12	16262.0	1.031	1.685	2.0162
13	17333.0	1.027	1.714	2.1490
14	18371.0	1.022	1.743	2.2777
15	19366.0	1.017	1.773	2.4010
16	20330.0	1.013	1.804	2.5205
17	21257.0	1.009	1.837	2.6355
18	22.38.0	1.005	1.871	2.7447
19	22970.0	1.001	1.090	2.8478
20	23762.0	0.996	1.051	2.9460

*Reference 16.

Table 10*

ADDITIONAL DATA NEEDED FOR THE CO MOLECULE

(μ = 6.85841)

State	De	Be	αe	γe	Te
$X^1\Sigma^+$	89597.4	1.93127	0.617513	2.960E-6	0.0
$A^1\pi$	24522.8	1.226	0.018	0.0	133740.0

*Gilmore, DASA Handbook 1917 old copy Volume I tables.

3. N_2 (NITROGEN) BAND SYSTEMS

The potentials used to calculate the Franck-Condon factors for the nitrogen systems came from several sources. The $X^1\Sigma_g^+$, $A^3\Sigma_u^+$, $B^3\pi_u$, and $C^3\pi_u$ states contained in tables 11 through 14 were taken from the paper by Benesch et al. (Ref. 18). The potentials used for the $b^1\pi_u$ and $b'^1\Sigma_u^+$ states were generated at AFWL with program TURNGPT and are listed in tables 15 and 16, respectively. The data for the $b^1\pi_u$ state are from Lofthus (Ref. 19) and the data for the $b'^1\Sigma_u^+$ state are from Wilkinson (Ref. 20). These data are listed in tables 17 through 18.

Table 11*

POTENTIAL ENERGY FOR THE N_2 $X^1\Sigma_g^+$ STATE

v	$V(cm^{-1})$	$r_{min}(\mathring{A})$	$r_{max}(\mathring{A})$	$V_{(ev)}$
0	1175.5	1.055_0	1.145_6	0.14573
1	3505.2	1.026_6	1.184_3	0.42456
2	5806.5	1.008_3	1.213_0	0.71987
3	8079.2	0.994_2	1.237_7	1.00163
4	10323.3	0.982_6	1.260_0	1.27985
5	12538.8	0.972_5	1.280_9	1.55452
6	14725.4	0.963_6	1.300_7	1.82561

Table 11* (cont'd)

v	V(cm^{-1})	r_{min}(Å)	r_{max}(Å)	$V_{(ev)}$
7	16883.1	0.955_6	1.319_7	2.09311
8	19011.8	0.948_4	1.338_2	2.35702
9	21111.5	0.941_7	1.356_1	2.61733
10	23182.0	0.935_5	1.373_8	2.87403
11	25223.3	0.929_8	1.391_1	3.12710
12	27235.3	0.924_4	1.408_2	3.37654
13	29218.0	0.919_4	1.425_2	3.62235
14	31171.2	0.914_6	1.442_0	3.86450
15	33094.9	0.910_1	1.458_8	4.10300
16	34989.0	0.905_8	1.475_5	4.33782
17	36853.5	0.901_7	1.492_1	4.56898
18	38688.3	0.897_8	1.508_8	4.79645
19	40493.4	0.894_0	1.525_5	5.02024
20	42268.6	0.890_4	1.542_3	5.24032
21	44014.1	0.887_0	1.559_1	5.45672

*Reference 18.

Table 12*

POTENTIAL ENERGY FOR THE N_2 $A^3\Sigma_u^+$ STATE

v	V(cm^{-1})	r_{min}(Å)	r_{max}(Å)	$V_{(ev)}$
0	726.80	1.2329	1.3482	0.0901
1	2159.67	1.1979	1.3992	0.2678
2	3564.87	1.1758	1.4378	0.4420
3	4942.36	1.1589	1.4715	0.6127
4	6292.03	1.1450	1.5025	0.7801
5	7613.75	1.1332	1.5319	0.9439

Table 12* (cont'd)

v	V(cm^{-1})	r_{min}(Å)	r_{max}(Å)	$V_{(ev)}$
6	8907.33	1.1229	1.5602	1.1043
7	10172.54	1.1138	1.5877	1.2612
8	11409.10	1.1055	1.6149	1.4145
9	12616.69	1.0980	1.6417	1.5642
10	13794.95	1.091_1	1.668_5	1.7103
11	14943.47	1.084_7	1.695_3	1.8526
12	16061.80	1.078_7	1.722_2	1.9913
13	17149.44	1.073_2	1.749_3	2.1261

*Reference 18.

Table 13*

POTENTIAL ENERGY FOR THE N_2 $B^3\pi_g$ STATE

v	V(cm^{-1})	r_{min}(Å)	r_{max}(Å)	$V_{(ev)}$
0	863.16	1.1631	1.2689	0.10702
1	2568.14	1.1306	1.3150	0.31840
2	4244.46	1.1099	1.3497	0.52623
3	5891.92	1.0940	1.3798	0.73049
4	7510.38	1.0809	1.4074	0.93114
5	9099.74	1.0697	1.4334	1.12819
6	10659.92	1.0599	1.4583	1.32163
7	12190.86	1.0511	1.4825	1.51144
8	13692.50	1.0432	1.5061	1.69761
9	15164.76	1.0360	1.5294	1.88014
10	16607.54	1.0294	1.5524	2.05902
11	18020.70	1.0233	1.5753	2.23422
12	19404.04	1.0176	1.5981	2.40573

Table 13* (cont'd)

v	$V(cm^{-1})$	$r_{min}(\AA)$	$r_{max}(\AA)$	$V_{(ev)}$
13	20757.31	1.012_3	1.621_0	2.57351
14	22080.16	1.007_4	1.644_0	2.73752
15	23372.16	1.002_7	1.667_2	2.89770
16	24632.76	0.998_2	1.690_6	3.05399
17	25861.32	0.994_0	1.714_3	3.20631

*Reference 18.

Table 14*

POTENTIAL ENERGY FOR THE N_2 $C^3\pi_u$ STATE

v	$V(cm^{-1})$	$r_{min}(\AA)$	$r_{max}(\AA)$	$V_{(ev)}$
0	1016.71	1.1030	1.2005	0.12605
1	3011.11	1.0730	1.2438	0.37332
2	4951.90	1.0540	1.2771	0.61394
3	6825.93	1.0395	1.3076	0.84629
4	8607.21	1.0282	1.3388	1.06713

*Reference 18.

Table 15*

POTENTIAL ENERGY OF THE N_2 $b^1\pi_u$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	412.5	1.23007	1.38773	0.0511
1	1114.5	1.16992	1.45950	0.1381
2	1779.5	1.13007	1.51097	0.2206
3	2407.5	1.09562	1.55852	0.2984
4	2992.5	1.06450	1.60407	0.3710

Table 15* (cont'd)

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
5	3546.5	1.03665	1.64718	0.4396
6	4062.5	1.00840	1.69329	0.5036
7	4542.4	0.98508	1.73570	0.5631

*From TURNGPT using Lofthus data.

Table 16*

POTENTIAL ENERGY OF THE N_2 $b'^1\Sigma_u^+$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	374.6	1.36740	1.52792	0.0464
1	1116.6	1.31442	1.59394	0.1384
2	1848.9	1.38936	1.65220	0.2292
3	2571.6	1.25162	1.68331	0.3188
4	3284.7	1.22812	1.72036	0.4072
5	3988.2	1.20746	1.75474	0.4944
6	4682.0	1.18887	1.78724	0.5804

*From TURNGPT using Wilkinson data.

Table 17

ADDITIONAL DATA NEEDED FOR THE N_2 MOLECULE

State	De	Be	αe	γe	Te
$X^1\Sigma_g^+$	78717.0	1.9987	0.0178	0.0	0.0
$A^3\Sigma_u^+$	28499.0	1.4545	0.01794	-9.2×10^{-5}	50218.0
$B^3\pi_u$	38306.0	1.6375	0.01794	-7.4×10^{-5}	59639.0
$C^3\pi_u$	28643.0	1.8259	0.0197	0.0	69302.0

Table 17 (cont'd)

State	De	Be	αe	γe	Te
$b^1\pi_u$	55655.0*	1.154	0.0048	0.0	104473.0
$b'^1\Sigma_u^+$	55655.0*	---	---	---	102288.0

*Estimated value.

Table 18

MOLECULAR DATA NEEDED FOR TURNGPT $\left(N_2\ b'^1\Sigma_{u_1}^+\right)$

State	We	Wexe	Weye	Weze	Be	αe	γe	re
$b'^1\Sigma_u^+$	751.64	4.82	0	0	1.154	0.0048	0	1.4443

Table 19

MOLECULAR DATA NEEDED FOR TURNGPT $\left(N_2\ b^1\pi_u\right)$

v	Gv	Bv
0	0	1.41
1	702	1.41
2	1367	1.40
3	1995	1.41
4	2580	1.48
5	3134	1.47
6	3650	---

4. N_2^+ (NITROGEN MOLECULAR ION) BAND SYSTEMS

The potentials used to generate the Franck-Condon factors for the N_2^+ band systems were calculated with program TURNGPT. The $A^2\pi_u$ and $C^2\Sigma_u^+$ states were generated using spectroscopic constants given by Gilmore (Ref. 21). These are given in table 24. The $X^2\Sigma_g^+$ and $B^2\Sigma_u^+$ states were generated by using spectroscopic data from Lofthus (Ref. 19). These data are listed in tables 25 and 26. The B_v for the missing levels was obtained by graphical interpolation. The

generated potentials are listed in tables 20 through 23.

Table 20*

POTENTIAL ENERGY FOR THE N_2^+ $X^2\Sigma_g^+$ STATE

v	V(cm^{-1})	r_{min}	r_{max}
0	1099.4	1.07794	1.1664
1	3274.2	1.04341	1.20672
2	5416.4	1.02546	1.23763
3	7525.8	1.01122	1.26388
4	9602.2	0.99944	1.28783
5	11645.4	0.97947	1.20991
6	13654.4	0.97947	1.33082
7	15630.1	0.97184	1.35192
8	17570.0	0.96441	1.37203
9	19477.0	0.95803	1.39205
10	21349.0	0.95185	1.41160
11	23185.9	0.94604	1.43092
12	24987.0	0.94066	1.45022
13	26751.8	0.93552	1.46943
14	28479.9	0.93092	1.48894
15	30171.0	0.92638	1.50835
16	31824.5	0.92239	1.52823
17	33439.9	0.91853	1.54825
18	35016.7	0.91482	1.56848
19	36554.0	0.91152	1.58931
20	38051.7	0.90810	1.61014

*From Lofthus data.

Table 21*

POTENTIAL ENERGY FOR THE N_2^+ $A^2\pi_u$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	947.96	1.02650	1.22743	0.1175
1	2821.38	1.09570	1.27158	0.3498
2	4664.80	1.07615	1.30488	0.5783
3	6478.22	1.06118	1.33368	0.8031
4	8271.64	1.04887	1.38479	1.0242
5	10015.06	1.03838	1.38479	1.2416
6	11738.48	1.02917	1.40847	1.4553
7	13431.90	1.02097	1.43137	1.6652
8	15095.32	1.01357	1.45371	1.8714
9	16728.74	1.00681	1.47563	2.0739
10	18332.16	1.00061	1.40726	2.2727
11	19905.58	0.99487	1.51867	2.4678
12	21449.00	0.98954	1.53995	2.6791
13	22962.42	0.98455	1.56116	2.8468
14	24445.84	0.97987	1.58235	3.0307
15	25897.26	0.97546	1.60356	3.2109
16	27322.68	0.97130	1.62484	3.3880
17	28716.10	0.967356	1.64622	2.5601
18	30079.52	0.96361	1.66774	3.7291
19	31412.94	0.96003	1.68943	3.8944
20	32716.36	0.95662	1.71132	4.0560

*From Gilmore's constants.

Table 22*

POTENTIAL ENERGY FOR THE N_2^+ $B^2\Sigma_u^+$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	V(ev)
0	1197.15	1.03331	1.12304	0.1484
1	3588.66	1.00546	1.16196	0.4424
2	5887.46	0.98795	1.19199	0.7299
3	9147.86	0.97409	1.21811	1.0101
4	10344.26	0.96323	1.24330	1.2824
5	12467.06	0.95501	1.26903	1.5456
6	14508.06	0.94720	1.27401	1.7986
7	16459.16	0.94043	1.32000	2.0405
8	18291.36	0.93404	1.34765	2.2677
9	20018.26	0.92856	1.37643	2.4818
10	21614.96	0.92315	1.40798	2.6797
11	23094.86	0.91867	1.44118	2.8632
12	24466.26	0.91496	1.117632	3.0332
13	25742.56	0.91145	1.51208	3.1914
14	26938.86	0.90846	1.54832	3.3397
15	28065.46	0.90544	1.58452	3.4794
16	29132.56	0.90303	1.62095	3.6117
17	30148.06	0.90104	1.65763	3.7376
18	31114.06	0.89893	1.69439	3.8574
19	32036.06	0.89687	1.73160	3.9717
20	32858.06	0.89012	1.78474	4.0736

*From Lofthus data.

Table 23*

POTENTIAL ENERGY FOR THE N_2^+ $C^2\Sigma_u^+$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	$V_{(ev)}$
0	1034.08	1.21465	1.31124	0.1282
1	3085.06	1.18158	1.34967	0.3824
2	5111.94	1.15962	1.37772	0.6337
3	7113.28	1.14238	1.40182	0.8818
4	9087.64	1.12798	1.42383	1.1266
5	11033.58	1.11558	1.44462	1.3679
6	12949.66	1.10471	1.46470	1.6054
7	14832.44	1.09508	1.48437	1.8391
8	16686.48	1.08646	1.50386	2.0687
9	18504.34	1.07874	1.52333	2.2941
10	20286.58	1.07182	1.54294	2.5150

*From Gilmore's constants

Table 24

ADDITIONAL DATA NEEDED FOR THE N_2^+ MOLECULE

State	We	Wexe	Weye	Weze	WeTe	Te
$X^2\Sigma_g^+$	2207.17	16.146	-2.85×10^{-2}	9.2×10^{-4}	0	0.0
$A^2\pi_u$	1903.42	15.0	0.0	0.0	0	8219.6
$B^2\Sigma_u^+$	2418.7	22.53	-6.70×10^{-1}	4.0×10^{-2}	0	25461.6
$C^2\pi_u^+$	2073	10.97	-2.40×10^{-1}	0.0	0	64607.5

State	Be	αe	γe	δe	re
$X^2\Sigma_g^+$	1.9258	0.01743	-1.64×10^{-4}	0	1.118
$A^2\pi_u$	1.748	0.02	0.00	0	1.117
$B^2\Sigma_u^+$	2.083	0.0183	-1.65×10^{-3}	0	1.075
$C^2\Sigma_u^+$	1.5124	0.0017	-7.50×10^{-4}	0	1.262

Table 25

MOLECULAR DATA NEEDED FOR TURNGPT $\left(N_2^+ \; X^2\Sigma_g^+\right)$

v	G_v	B_v
0	1099.4	1.922
1	3274.2	1.902
2	5416.4	1.879
3	7525.8	1.861
4	9602.2	1.841
5	11645.2	1.826
6	13654.4	1.808
7	15630.1	1.781
8	17570.0	1.766
9	19477.0	1.740
10	21349.1	1.724
11	23185.9	1.703
12	24987.0	1.683
13	26751.8	1.663
14	28479.9	1.639
15	30171.0	1.620
16	31824.5	1.593
17	33439.9	1.572
18	35016.7	1.548
19	36554.0	1.522
20	38051.7	1.500

Table 26

MOLECULAR DATA NEEDED FOR TURNGPT N_2^+ $B^2\Sigma_u^+$

v	Gv	Bv
0	1197.16	2.073
1	3568.66	2.049
2	5887.46	2.025
3	8147.86	2.002
4	10344.26	1.968
5	12467.06	1.926
6	14508.06	1.896
7	16459.16	1.896
8	18291.36	1.81
9	20018.26	1.761
10	21614.06	1.710
11	23094.86	1.653
12	24466.26	1.595
13	25742.56	1.545
14	26938.86	1.494
15	28065.46	1.452
16	29132.56	1.404
17	30148.06	1.361
18	31114.06	1.323
19	32036.06	1.285
20	32858.06	1.250

5. NO (NITRIC OXIDE) BAND SYSTEMS

The molecular potentials used to calculate the various NO band system Franck-Condon factors came from three sources. The $X^2\pi_{1/2}$, $X^2\pi_{3/2}$ states were from Vanderslice (Ref. 23). The $A^2\Sigma^+$, $B^2\pi$, $C^2\pi$, $B'^2\Delta$, $E^2\Sigma^+$ states were from Vanderslice et al. (Ref. 22). The NO $D^2\Sigma^+$ state potential was generated with program TURNGPT using molecular constants from Gilmore (Ref. 21). The potentials are listed in tables 27 through 34. The spectroscopic constants used to generate the D state potential are listed in table 35.

Table 27*

POTENTIAL ENERGY FOR THE NO $X^2\pi_{1/2}$ STATE

v	V(cm^{-1})	r_{max}(Å)	r_{min}(Å)	V(ev)
0	948.5	1.202	1.105	0.1176
1	2825.0	1.245	1.074	0.3503
2	4673.0	1.276	1.055	0.5795
3	6493.0	1.304	1.041	0.8051
4	8285.0	1.329	1.028	1.027
5	10048.0	1.352	1.018	1.246
6	11784.0	1.375	1.009	1.461
7	13492.0	1.396	1.000	1.673
8	15172.0	1.417	0.993	1.881
9	16824.0	1.438	0.986	2.086
10	18448.0	1.458	0.974	2.388
11	20044.0	1.478	0.980	2.485
12	21613.0	1.497	0.974	2.680
13	23152.0	1.517	0.968	2.871
14	24665.0	1.537	0.963	3.058
15	26149.0	1.556	0.958	3.131
16	27605.0	1.576	0.954	3.423
17	29034.0	1.596	0.945	3.600

Table 27* (cont'd)

v	$V(cm^{-1})$	$r_{max}(Å)$	$r_{min}(Å)$	$V_{(ev)}$
18	30434.0	1.615	0.941	3.774
19	31805.0	1.636	0.937	3.944
20	33141.0	1.656	0.934	4.109
21	34443.0	1.677	0.930	4.271
22	35714.0	1.698	0.926	4.418
23	36953.0	1.719	0.923	4.582

*Reference 23.

Table 28*

POTENTIAL ENERGY FOR THE NO $X^2\pi_{3/2}$ STATE

v	$V(cm^{-1})$	$r_{max}(Å)$	$r_{min}(Å)$	$V_{(ev)}$
0	948.5	1.204	1.106	0.1176
1	2825.0	1.246	1.076	0.3503
2	4673.0	1.278	1.057	0.5795
3	6493.0	1.305	1.042	0.8051
4	8285.0	1.330	1.030	1.027
5	10048.0	1.354	1.019	1.246
6	11784.0	1.376	1.010	1.461
7	13492.0	1.397	1.002	1.673
8	15172.0	1.418	0.994	1.881
9	16824.0	1.439	0.987	2.086
10	18448.0	1.459	0.981	2.288
11	20044.0	1.479	0.975	2.485
12	21613.0	1.499	0.969	2.680
13	23152.0	1.518	0.964	2.871

Table 28* (cont'd)

v	$V(cm^{-1})$	$r_{max}(\mathring{A})$	$r_{min}(\mathring{A})$	$V_{(ev)}$
14	24663.0	1.538	0.959	3.058
15	26145.0	1.558	0.955	3.242
16	27599.0	1.577	0.950	3.422
17	29024.0	1.597	0.946	3.599
18	30423.0	1.617	0.942	3.772
19	31790.0	1.637	0.938	3.942
20	33124.0	1.657	0.934	4.107
21	34424.0	1.678	0.930	4.269
22	35695.0	1.698	0.926	4.426
23	36938.0	1.719	0.923	4.580

*Reference 23.

Table 29*

POTENTIAL ENERGY FOR THE NO $A^2\Sigma^+$ STATE

v	$V(cm^{-1})$	$r_{max}(\mathring{A})$	$r_{min}(\mathring{A})$	$V_{(ev)}$
0	1183.0	1.109	1.022	0.1467
1	3525.0	1.147	0.995	0.4371
2	5835.0	1.175	0.977	0.7235
3	8111.0	1.199	0.964	1.006
4	10354.0	1.220	0.953	1.284
5	12564.0	1.242	0.943	1.558

*Reference 23.

Table 30*

POTENTIAL ENERGY OF THE NO $B^2\pi$ STATE

v	$V(cm^{-1})$	$r_{max}(\mathring{A})$	$r_{min}(\mathring{A})$	$V_{(ev)}$
0	516.8	1.488	1.356	0.0641
1	1540.0	1.545	1.315	0.191
2	2549.0	1.588	1.289	0.316
3	3545.0	1.625	1.269	0.440
4	4519.0	1.658	1.253	0.560
5	5492.0	1.690	1.239	0.681
6	6447.0	1.719	1.226	0.799
7	7390.0	1.748	1.215	0.917
8	8323.0	1.776	1.205	1.032
9	9238.0	1.804	1.196	1.146
10	10144.0	1.831	1.188	1.258
11	11030.0	1.857	1.180	1.368
12	11911.0	1.883	1.173	1.477
13	12772.0	1.909	1.167	1.584
14	13609.0	1.935	1.161	1.688
15	14463.0	1.962	1.154	1.793
16	15293.0	1.989	1.147	1.896
17	16081.0	2.015	1.142	1.994
18	16859.0	2.041	1.136	2.091
19	17612.0	2.068	1.130	2.184

*Reference 23.

Table 31*

POTENTIAL ENERGY OF THE NO $C^2\pi$ STATE

v	$V(cm^{-1})$	$r_{max}(Å)$	$r_{min}(Å)$	$V_{(ev)}$
0	1194.0	1.109	1.022	0.1481
1	3556.0	1.148	0.997	0.4409
2	5922.0	1.178	0.981	0.7343
3	8192.0	1.204	0.970	1.016
4	10491.0	1.228	0.961	1.301

*Reference 23.

Table 32*

POTENTIAL ENERGY OF THE NO $B'^2\Delta$ STATE

v	$V(cm^{-1})$	$r_{max}(Å)$	$r_{min}(Å)$	$V_{(ev)}$
0	604.0	1.368	1.246	0.07493
1	1789.0	1.424	1.209	0.2219
2	2943.0	1.466	1.186	0.3649
3	4062.0	1.503	1.168	0.5037
4	5177.0	1.539	1.153	0.6420
5	6212.0	1.570	1.139	0.7703

*Reference 23.

Table 33*

POTENTIAL ENERGY OF NO $E^2\Sigma^+$ STATE

v	$V(cm^{-1})$	$r_{max}(\mathring{A})$	$r_{min}(\mathring{A})$	$V_{(ev)}$
0	1183.0	1.112	1.025	0.1467
1	3525.0	1.150	0.997	0.4371
2	5835.0	1.177	0.980	0.7235
3	8114.0	1.202	0.966	1.006
4	10360.0	1.223	0.955	1.285
5	12575.0	1.244	0.945	1.559

*Reference 23.

Table 34*

POTENTIAL ENERGY FOR THE NO $D^2\Sigma^+$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	1156.336	1.02039	1.10891	0.1433
1	3438.004	0.99320	1.14762	0.4262
2	5687.031	0.97601	1.17645	0.7050
3	7918.479	0.97601	1.20099	0.9817
4	10152.686	0.96318	1.22264	1.2586
5	12415.274	0.94545	1.24187	1.5392
6	14737.141	0.93970	1.25881	1.8270
7	17154.469	0.93579	1.27350	2.1267

*From TURNGPT using Gilmore's constants

Table 35

MOLECULAR DATA NEEDED FOR TURNGPT (NO $D^2\Sigma$)

We	Wexe	Weye	Weze	Be	αe	γe	re
2323.9	22.885	0.75	0.22	2.0026	2.175×10^{-2}	0	1.062

6. O_2 (OXYGEN) BAND SYSTEM

Franck-Condon factors were calculated for only the O_2 Schumann-Runge band system. The potentials needed, O_2 $X^3\Sigma$ and O_2 $B^3\Sigma$, were calculated with program TURNGPT using data from Wallace (Ref. 24). The G, ΔG, B_v were each plotted and the best smooth curve was drawn through these. These smoothed values were then used as input data to TURNGPT. The $B^3\Sigma$ state was found to have a hook near the dissociation limit on the inner branch of the potential curve. This is similar to the findings of many other investigators, for example, Vanderslice et al. (Ref. 25), F. Gilmore (Ref. 26), Richards and Barrow (Ref. 27),* Ginter, Battino (Ref. 28).

A potential which is not single valued causes numerical difficulties when one attempts to find solutions for the wave functions needed to calculate overlap integrals. To avoid this problem the calculated potential for the $B^3\Sigma$ state was used up to the vibrational level where the hook started to occur. First an extrapolation of the form a/r^{12} was used. (This procedure is similar to that used by Halmann and Laulicht (Ref. 29) who used Vanderslice's potential for their calculations.) Using the resulting potential to find the maximum of the Shcumann-Runge continuum by the reflection method, one finds that it occurs at a much too high energy. An alternate method for constructing a more realistic potential in the troublesome region involves using the calculated potential at values of vibrational quantum number where one believes the calculation and using Evans and Schexander's (Ref. 30) values for the potential in the continuum portion of the potential and interpolating through the troublesome region. Franck-Condon factors were calculated using the so determined potentials.

*They claim no anomaly though.

Table 36*

POTENTIAL ENERGY FOR THE O_2 $X^3\Sigma_g^-$ STATE

v	V(cm^{-1})	r_{min}	r_{max}
0	789.81	1.15966	1.26310
1	2352.20	1.12759	1.30786
2	3891.68	1.10739	1.34156
3	5408.25	1.09177	1.37059
4	6901.91	1.07892	1.39709
5	8372.64	1.06791	1.42192
6	9820.43	1.05849	1.44586
7	11245.26	1.04980	1.46867
8	12647.12	1.04186	1.49078
9	14025.99	1.03482	1.51266
10	15381.88	1.02825	1.53410
11	16714.79	1.02215	1.55527
12	18024.69	1.01657	1.56737
13	19311.59	1.01136	1.59734
14	20575.48	1.00645	1.61823
15	21816.33	1.00183	1.63910
16	23034.10	0.99764	1.66018
17	21228.74	0.99367	1.68130
18	25400.22	0.98988	1.70249
19	26548.54	0.98618	1.72369
20	27673.62	0.98325	1.74566
21	28775.15	0.97498	1.76236
22	29852.56	0.97249	1.78501
23	30905.29	0.97124	1.80913

*From TURNGPT

Table 37*

POTENTIAL ENERGY FOR THE O_2 $B^3\Sigma_u^-$ STATE

v	V(cm^{-1})	r_{min}	r_{max}
0	353.45	1.52754	1.68252
1	1041.45	1.46883	1.75912
2	1706.55	1.45786	1.81448
3	2347.95	1.43628	1.86469
4	2965.55	1.41890	1.91241
5	3557.35	1.40495	1.96052
6	4118.45	1.39306	2.00873
7	4651.65	1.37998	2.05627
8	5153.05	1.36959	2.01829
9	5618.55	1.36125	2.16443
10	6047.45	1.35429	2.22607
11	6435.65	1.34833	2.29561
12	6781.05	1.34334	2.37479
13	7081.75	1.33902	2.46677
14	7336.75	1.33507	2.57613
15	7545.15	1.33088	2.70806
16	7714.11	1.32861	2.86245
17	7847.02	1.32627	3.04965
18	7949.15	1.32496	3.27710
19	8024.79	1.32740	3.56375
20	8077.44	1.33034	3.94952

*From TURNGPT

Table 38

MOLECULAR DATA NEEDED FOR TURNGPT $\left(O_2\ X^3\Sigma_g^-\right)$

v	Gv(cm^{-1})	Bv(cm^{-1})
0	789.81	1.4375
1	2352.20	1.4215
2	3891.68	1.406
3	5408.25	1.3909
4	6901.91	1.3755
5	8372.64	1.3601
6	9820.43	1.343
7	11245.26	1.3296
8	12647.12	1.3145
9	14026.00	1.298
10	15381.88	1.2833
11	16714.79	1.2678
12	18024.69	1.2516
13	19311.59	1.236
14	20575.48	1.2204
15	21816.33	1.2046
16	23034.10	1.1870
17	24228.74	1.1711
18	25400.22	1.1550
19	26548.54	1.1390
20	27673.62	1.1226
21	28775.15	1.640
22	29852.56	1.0904
23	30905.29	1.0744

Table 39

MOLECULAR DATA NEEDED FOR TURNGPT (O_2 $B^3\Sigma_u^-$)

v	Gv(cm^{-1})	Bv(cm^{-1})
0	353.45	0.813
1	1041.45	0.798
2	1706.55	0.785
3	2347.95	0.770
4	2965.55	0.754
5	3557.35	0.735
6	4118.45	0.719
7	4652.65	0.703
8	5153.05	0.680
9	5618.55	0.655
10	6047.45	0.627
11	6435.65	0.596
12	6781.05	0.562
13	7081.75	0.525
14	7336.75	0.485
15	7545.15	0.443
16	7714.11	0.398
17	7847.02	0.354
18	7949.15	0.306
19	8024.79	0.258
20	8077.44	0.208
21	8109.38	0.159
22	8126.28	0.109

Table 39 (cont'd)

CONTINUUM VALUES

9150.0	1.31
9560.0	1.305
9970.0	1.300
10380.0	1.295
10780.0	1.290
11200.0	1.285
11640.0	1.28

Table 40

POTENTIAL ENERGY INPUT DATA USED FOR CALCULATING THE FRANCK-CONDON FACTORS FOR O_2 SCHUMANN-RUNGE BAND SYSTEMS

v	V(cm^{-1})	r_{min}	r_{max}
0	353.45	1.52754	1.68252
1	1041.45	1.46883	1.75912
2	1706.55	1.45786	1.81448
3	2347.95	1.43628	1.86469
4	2965.55	1.41890	1.91241
5	3557.35	1.40495	1.96052
6	4118.45	1.39306	2.00873
7	4652.65	1.37998	2.05627
8	5153.05	1.36959	2.10829
9	5618.55	1.36125	2.16443
10	6047.45	1.35429	2.22607
11	6435.65	1.34833	2.29561
12	6781.05	1.34334	2.37479
13	7081.75	1.33902	2.46677
14	7336.75	1.33507	2.57613

Table 40 (cont'd)

v	V(cm^{-1})	r_{min}	r_{max}
15	7545.15	---	2.70806
16	7714.11	---	2.86245
17	7847.02	---	3.04965
18	7949.15	---	3.27710
19	8024.79	---	3.56375
20	8077.44	---	3.94952

7. PHOTOIONIZATION FRANCK-CONDON FACTORS

a. N_2

The four photoionization transitions considered were

(1) $N_2\ X^1\Sigma_g^+ \rightarrow N_2^+\ X^2\Sigma_g^+$,

(2) $N_2\ X^1\Sigma_g^+ \rightarrow N_2^+\ A^2\pi_u$,

(3) $N_2\ X^1\Sigma_g^+ \rightarrow N_2^+\ B^2\Sigma_u^+$,

(4) $N_2\ X^1\Sigma_g^+ \rightarrow N_2^+\ C^2\Sigma_u^+$.

All five potentials used were generated using program TURNGPT and with the exception of the B state were generated from spectroscopic constants given by Gilmore (Ref. 21). The B state was generated by use of constants from Herzberg (Ref. 29).

Table 46 contains the spectroscopic data used. Tables 41 through 45 contain the generated potentials.

Table 41*

POTENTIAL ENERGY FOR THE N_2 $X^1\Sigma_g^+$ STATE

v	V(cm^{-1})	r_{min}	r_{max}
0	1175.49	1.05485	1.14544
1	3505.14	1.02644	1.18417
2	5806.91	1.06820	1.21288
3	8078.91	0.99410	1.23755
4	10322.88	0.98242	1.25993
5	12538.14	0.97236	1.28081
6	1.4724.61	0.96349	1.30064
7	16882.22	0.95552	1.31968
8	19010.90	0.94829	1.33813
9	21110.57	0.94164	1.35612
10	23181.15	0.93550	1.37375
11	25222.58	0.92978	1.39111
12	27234.78	0.92443	1.40825
13	39317.67	0.91940	1.42522
14	31171.18	0.91464	1.44208
15	33095.24	0.91014	1.45884
16	34989.77	0.90586	1.47556
17	36854.69	0.90178	1.49224
18	38689.94	0.89788	1.50893
19	40495.43	0.89415	1.152564
20	52271.10	0.89056	1.54240

*From TURNGPT using Gilmore's constants.

Table 42*

POTENTIAL ENERGY FOR THE N_2^+ $X^2\Sigma_g^+$ STATE

v	V(cm^{-1})	r_{min}	r_{max}
0	1099.54	1.07397	1.16768
1	3274.34	1.04461	1.20792
2	5416.60	1.02575	1.23791
3	7526.22	1.01120	1.26385
4	9603.09	0.99917	1.28752
5	11647.12	0.98884	1.30976
6	13658.25	0.97978	1.33100
7	15636.45	0.97170	1.35156
8	17581.70	0.96440	1.37161
9	19494.00	0.95777	1.39130
10	21373.38	0.95169	1.41075
11	23219.89	0.94611	1.43002
12	25033.61	0.94096	1.44919
13	26814.62	0.93619	1.46831
14	28563.05	0.93178	1.48743
15	30279.03	0.92768	1.50659
16	31962.72	0.92389	1.52582
17	33614.31	0.92037	1.54515
18	35233.99	0.91712	1.56462
19	36822.00	0.91412	1.58424
20	38378.58	0.91136	1.60404

*From TURNGPT using Gilmore's constants.

Table 43*

POTENTIAL ENERGY FOR THE N_2^+ $A^2\pi_u$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	V(ev)
0	947.96	1.02656	1.22743	0.1175
1	2821.38	1.09570	1.27158	0.3498
2	4664.80	1.07615	1.30488	0.5783
3	6478.22	1.06118	1.33368	0.8031
4	8271.64	1.04887	1.38479	1.0242
5	10015.06	1.03838	1.38479	1.2416
6	11738.48	1.02917	1.40847	1.4553
7	13431.90	1.02097	1.43137	1.6652
8	15095.32	1.01357	1.45371	1.8714
9	16728.74	1.00681	1.47563	2.0739
10	18332.16	1.00061	1.49726	2.2727
11	19905.58	0.99487	1.51867	2.4678
12	21449.00	0.98954	1.53995	2.6791
13	22962.42	0.98455	1.56116	2.8468
14	24445.84	0.97987	1.58235	3.0307
15	25897.26	0.97546	1.60356	3.2109
16	27322.68	0.97130	1.62484	3.3880
17	28716.10	0.967356	1.64622	3.5601
18	30079.51	0.96361	1.66774	3.7291
19	31412.94	0.96003	1.68943	3.8944
20	32716.36	0.95662	1.71132	4.0560

*From TURNGPT using Gilmore's constants.

Table 44

POTENTIAL ENERGY FOR THE N_2^+ $B^2\Sigma_u^+$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	1197.15	1.03331	1.12304	0.1484
1	3588.66	1.00546	1.16196	0.4424
2	5887.46	0.98795	1.19199	0.7299
3	8147.86	0.97409	1.21811	1.0101
4	10344.26	0.96323	1.24330	1.2824
5	12467.06	0.95501	1.26903	1.5456
6	14508.06	0.94720	1.27401	1.7986
7	16469.16	0.94043	1.32000	2.0405
8	18291.36	0.93404	1.34765	2.2677
9	20018.26	0.92856	1.37643	2.4818
10	21614.96	0.92315	1.40798	2.6797
11	23094.86	0.91867	1.44118	2.8632
12	24466.26	0.91496	1.117632	3.0332
13	25742.56	0.91145	1.51208	3.1914
14	26938.86	0.90846	1.54832	3.3397
15	28065.46	0.90544	1.58452	3. 794
16	29132.56	0.90303	1.62095	3.6117
17	30148.06	0.90104	1.65763	3.7376
18	31114.06	0.89893	1.69439	3.8574
19	32036.06	0.89687	1.73160	3.9717
20	32858.06	0.89012	1.78474	4.0736

Table 45*

POTENTIAL ENERGY FOR THE N_2^+ $C^2\Sigma_u^+$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	V(ev)
0	1034.08	1.21465	1.31124	0.1282
1	3085.06	1.18158	1.34967	0.3824
2	5111.94	1.15962	1.37772	0.6337
3	7113.28	1.14238	1.49182	0.8818
4	9087.64	1.12798	1.42383	1.1266
5	11033.58	1.11558	1.44462	1.3679
6	12949.66	1.10471	1.46470	1.6054
7	14832.44	1.09508	1.48437	1.8391
8	16686.48	1.08646	1.50386	2.0687
9	18504.34	1.07874	1.52333	2.2941
10	20286.58	1.07182	1.54294	2.5150

*From TURNGPT using Gilmore's constants.

b. O_2

The photoionization transitions considered were

(1) $O_2\ X^3\Sigma_g^- \rightarrow O_2^+\ X^2\pi_g$,

(2) $O_2\ X^3\Sigma_g^- \rightarrow O_2^+\ A^4\pi_u$,

(3) $O_2\ X^3\Sigma_g^- \rightarrow O_2^+\ A^2\pi_u$,

(4) $O_2\ X^3\Sigma_g^- \rightarrow O_2^+\ b^4\Sigma_g^-$,

(5) $O_2\ X^3\Sigma_g^- \rightarrow O_2^+\ ^2\Sigma_g^-$,

(6) $O_2\ X^3\Sigma_g^- \rightarrow O_2^+\ C^4\Sigma_u^-$.

The seven potentials used were generated by program TURNGPT. The O_2 $X^3\Sigma_g^-$ state was generated by using data from Wallace (Ref. 24). This is the same potential that was used as the lower state of the O_2 S-R system. The six states of O_2^+ were all generated using the spectroscopic constants given by Gilmore (Ref. 21). These data are listed in table 53. The potentials are listed in table 47 through 52.

Table 46

SPECTROSCOPIC CONSTANTS FOR N_2 PHOTOIONIZATION STATES

We	Wexe	Weye	Weze	Be	αe	ye	re
			N_2 $X^1\Sigma_g^+$ state				
2358.07	14.188	-1.24^{-2}	0.0	1.9987	0.0178	0.0	1.0976
			N_2^+ $X^2\Sigma_g^+$ state				
2207.17	16.146	-2.85^{-2}	9.2^{-4}	1.9258	0.01743	-1.6^{-4}	1.118
			N_2^+ $A^2\pi_u$ state				
1903.42	15.0	0.0	0.0	1.748	0.02	0.0	1.117
			N_2^+ $B^2\Sigma_u^+$ state				
2418.7	22.53	-6.7^{-1}	4.0^{-2}	2.083	0.0183	-1.65^{-3}	1.075
			N_2^+ $C^2\Sigma_u^+$ state				
2073.7	10.97	-2.4^{-1}	0.0	1.5124	0.0017	-7.5^{-4}	1.262

Table 47*

POTENTIAL ENERGY FOR THE O_2^+ $X^2\pi_g$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	934.12	1.07839	1.17354	0.1158
1	2777.56	1.04947	1.21552	0.3444
2	2587.94	1.03116	1.247.4	0.5678
3	6365.26	1.01714	1.26466	0.7891
4	8109.52	1.00561	1.29990	1.0054

Table 47* (cont'd)

v	V(cm^{-})	r_{min}	r_{max}	$V_{(ev)}$
5	9820.72	0.99575	1.32370	1.2175
6	11498.86	0.98710	1.34652	1.4256
7	13143.94	0.97939	1.36865	1.6295
8	14755.96	0.97241	1.39030	1.8294
9	16334.92	0.96603	1.41161	2.0252
10	17880.82	0.96016	1.43268	2.2168
11	19393.66	0.95471	1.45362	2.4044
12	20873.44	0.94962	1.47448	2.5878
13	22320.16	0.94484	1.49534	2.7672
14	23733.82	0.94034	1.51624	2.9424

*From TURNGPT using Gilmore's constants.

Table 48*

POTENTIAL ENERGY FOR THE O_2^+ $A^2\pi_u$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	$V_{(ev)}$
0	446.08	1.34603	1.48386	0.0553
1	1317.68	1.30607	1.54794	0.1634
2	2161.88	1.28114	1.59762	0.2680
3	2978.68	1.26225	1.64192	0.3695
4	3768.08	1.24682	1.68348	0.4672
5	4530.08	1.23364	1.72353	0.5616
6	5246.68	1.22209	1.76277	0.6505
7	5971.88	1.21173	1.80167	0.7404
8	6651.88	1.20230	1.84057	0.8246
9	7304.08	1.19358	1.87975	0.9055
10	7929.08	1.08541	1.91945	0.9830

*From TURNGPT using Gilmore's constants.

Table 49*

POTENTIAL ENERGY FOR THE O_2^+ $b^4\pi$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	$V_{(ev)}$
0	594.11	1.22498	1.34439	0.0736
1	1756.70	1.19030	1.39967	0.2178
2	2885.11	1.16869	1.44240	0.3577
3	3979.34	1.15234	1.48038	0.4933
4	50 9.39	1.13900	1.51592	0.6248
5	6065.26	1.12765	1.55006	0.7520
6	7056.95	1.11772	1.58341	0.8749
7	8014.46	1.10886	1.61637	0.9936
8	8937.79	1.10082	1.64922	1.1081
9	9826.94	1.09343	1.68218	1.2183
10	10681.91	1.08656	1.71545	1.3243

*From TURNGPT using Gilmore's constants.

Table 50*

POTENTIAL ENERGY FOR THE O_2^+ $a^4\pi$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	$V_{(ev)}$
0	515.25	1.32207	1.45020	0.0639
1	1530.05	1.28390	1.50774	0.1897
2	2425.29	1.25993	1.55142	0.3130
3	3497.64	1.24174	1.58969	0.4336
4	4450.21	1.22690	1.62500	0.5517
5	5382.00	1.21429	1.65846	0.6672
6	6293.01	1.20332	1.69071	0.7802
7	7183.24	1.19358	1.72214	0.8906

Table 50* (cont'd)

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
8	8052.60	1.18484	1.75304	0.9983
9	8901.36	1.17690	1.78360	1.1036
10	9729.25	1.16963	1.81397	1.2062

*From TURNGPT using Gilmore's constants.

Table 51*

POTENTIAL ENERGY FOR THE O_2^+ $c^4\Sigma_u^-$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	1195.50	1.14677	1.23086	0.1482
1	3559.50	1.12238	1.26895	0.4413
2	5887.50	1.10740	1.29783	0.7299
3	8079,50	1.09628	1.32307	1.0141
4	10435.50	1.08740	1.34627	1.2938
5	12655.50	1.08006	1.368916	1.8390
6	14839.50	1.07383	1.28917	1.8398
7	16987.50	1.06847	1.40954	2.1060
8	19099.50	1.06382	1.42945	2.3679
9	21175.50	1.05974	1.44904	2.6253
10	23215.50	1.05916	1.46839	2.8782

*From TURNGPT using Gilmore's constants.

Table 52*

POTENTIAL ENERGY FOR THE $O_2^+ \ ^2\Sigma_g^-$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	$V_{(ev)}$
0	360.50	1.28272	1.43501	0.0447
1	1066.50	1.23627	1.50491	0.1322
2	1752.50	1.20657	1.55759	0.2173
3	2418.50	1.18361	1.60411	0.2998
4	3064.50	1.16440	1.64740	0.3799
5	3690.50	1.14791	1.68880	0.4575
6	4296.50	1.13310	1.72910	0.5327
7	4882.50	1.11970	1.76878	0.6053
8	5448.50	1.10730	1.80821	0.6755
9	5994.50	1.09572	1.84768	0.7432
10	6520.50	1.08478	1.88740	0.8084

*From TURNGPT using Gilmore's constants.

Table 53

SPECTROSCOPIC CONSTANTS FOR O_2 PHOTOIONIZATION STATES

We	Wexe	Weye	Weze	Be	αe	γe	re
				$O_2^+ \ X^2\pi_g$ state			
1876.50	16.53	0	0	1.67220	0.01984	0.0	1.12270
				$O_2^+ \ a^4\pi_u$ state			
1035.69	10.39	0	0	1.10461	0.01575	0.0	1.38126
				$O_2^+ \ A^2\pi_u$ state			
899.00	13.70	0	0	1.06170	0.01906	-1.95^{-4}	1.40890
				$O_2^+ \ b^4\Sigma_g^-$ state			
1196.77	17.09	0	0	1.28729	0.02206	0.0	1.27953

Table 53 (cont'd)

We	Wexe	Weye	Weze	Be	αe	γe	re
				$O_2^+ \ ^2\Sigma_g^-$ state			
726.00	10.00	0	0	1.15000	0.01700	0.0	estimated
				$O_2^+ \ c^4\Sigma_g^-$ state			
2400.00	18.00	0	0	1.50000	0.02000	0.0	estimated

SECTION III

TABLES OF FRANCK-CONDON FACTORS

This section contains tables of the Franck-Condon factors calculated from the data given in Section II. In Appendix I is a listing of program TURNGPT which was used to generate the input data for program FRANKON. The Franck-Condon factors have been calculated by program FRANKON which is listed in Appendix II.

Table 94 contains a list of R-K-R Franck-Condon factor tabulations known to the authors at the time this work was started. This list includes only transitions of interest for atmospheric diatomic molecules.

Table 54

RKR FRANCK-CONDON FACTORS FOR(CV RED (1/2))

V'V	J	1	2	3	4	5	6	7	8	9
0	4.991- 1	3.719- 1	1.104- 1	1.702- 2	1.409- 3	6.954- 5	1.774- 6	5.038- 8	1.387- 9	6.022-11
1	3.190- 1	4.579- 2	3.632- 1	2.222- 1	5.312- 2	6.259- 3	3.896- 4	1.293- 5	3.122- 7	2.281- 9
2	1.254- 1	2.387- 1	1.208- 2	2.145- 1	2.884- 1	1.038- 1	1.513- 2	1.250- 3	5.127- 5	1.124- 6
3	4.022- 2	1.933- 1	9.735- 2	9.004- 2	9.621- 2	2.995- 1	1.591- 1	3.218- 2	3.064- 3	1.453- 4
4	1.159- 2	9.494- 2	1.793- 1	1.467- 2	1.534- 1	1.459- 2	2.552- 1	2.094- 1	5.411- 2	6.267- 3
5	3.157- 3	3.592- 2	1.336- 1	1.197- 1	2.353- 3	1.593- 1	1.156- 3	2.040- 1	2.465- 1	8.174- 2
6	8.302- 4	1.259- 2	6.843- 2	1.398- 1	5.541- 2	3.277- 2	1.259- 1	2.634- 2	1.346- 1	2.646- 1
7	2.184- 4	4.850- 3	2.949- 2	9.517- 2	1.173- 1	1.272- 2	7.305- 2	7.756- 2	6.735- 2	7.238- 2
8	5.660- 5	1.249- 3	1.108- 2	4.977- 2	1.034- 1	7.995- 2	3.044- 5	1.014- 1	3.289- 2	1.049- 1
9	1.469- 5	3.734- 4	3.947- 3	2.234- 2	5.903- 2	1.045- 1	4.093- 2	1.175- 2	1.056- 1	5.984- 3
10	3.807- 6	1.104- 4	1.350- 3	9.142- 3	3.679- 2	9.358- 2	8.590- 2	1.259- 2	3.599- 2	9.040- 2
11	1.052- 6	3.252- 5	4.501- 4	3.533- 3	1.722- 2	5.187- 2	8.753- 2	5.957- 2	4.544- 4	6.026- 2
12	3.004- 7	9.733- 6	1.478- 4	1.315- 3	7.459- 3	2.759- 2	6.435- 2	8.123- 2	3.269- 2	4.001- 3
13	9.037- 8	2.877- 6	4.838- 5	4.775- 4	3.075- 3	1.342- 2	3.921- 2	7.159- 2	6.622- 2	1.188- 2
14	2.816- 8	9.402- 7	1.598- 5	1.709- 4	1.227- 3	5.181- 3	2.123- 2	5.031- 2	7.191- 2	4.637- 2
15	8.738- 9	3.053- 7	5.353- 6	6.051- 5	4.771- 4	2.536- 3	1.050- 2	3.020- 2	5.800- 2	6.484- 2
16	2.575- 9	1.007- 7	1.822- 6	2.156- 5	1.824- 4	1.117- 3	5.315- 3	1.659- 2	3.928- 2	6.137- 2
17	6.820-10	3.268- 8	6.226- 7	7.717- 6	6.943- 5	4.503- 4	2.293- 3	8.542- 3	2.376- 2	4.692- 2
18	1.819-10	9.879- 9	2.088- 7	2.760- 6	2.595- 5	1.952- 4	1.010- 3	4.131- 3	1.327- 2	3.125- 2

Table 54 (cont'd)

(CN RE) (1/2))

VV V	10	11	12	13	14	15	16	17	18
0	2.760-11	9.355-11	2.199-12	8.749-12	3.332-12	3.983-12	2.554-12	6.128-12	1.099-14
1	2.497- 9	1.357-10	5.673-10	1.832-10	7.835-11	8.557-11	8.393-12	3.451-11	4.829-13
2	8.006- 9	1.259- 9	6.143-10	8.080-11	6.897-10	5.583-11	2.084-10	1.307-10	3.147-11
3	3.560- 6	3.332- 9	2.137- 9	1.291-10	1.185-10	1.125-10	1.428-10	7.944-12	1.626-10
4	3.430- 4	9.062- 6	7.048- 9	2.918- 9	1.501- 9	9.303-10	7.308-10	1.061-11	4.403-12
5	1.133- 2	7.203- 4	2.040- 5	2.147- 7	2.628-11	2.623- 9	3.792-12	3.919- 9	1.801- 9
6	1.136- 1	1.966- 2	1.307- 3	4.442- 5	5.849- 7	6.441-12	7.248-10	9.501-12	2.432-10
7	2.720- 1	1.473- 1	2.408- 2	2.414- 3	9.621- 5	9.392- 7	7.547-10	6.663-12	5.633- 9
8	2.757- 2	2.574- 1	1.805- 1	4.159- 2	3.945- 3	1.532- 4	1.866- 6	1.495- 8	4.266- 9
9	1.271- 1	4.069- 3	2.285- 1	2.114- 1	5.731- 2	6.154- 3	2.722- 4	4.263- 6	4.543- 8
10	5.410- 4	1.301- 1	1.100- 3	1.897- 1	2.370- 1	7.500- 2	9.297- 3	4.590- 4	7.346- 6
11	6.342- 2	1.297- 2	1.155- 1	1.454- 2	1.457- 1	2.534- 1	9.728- 2	1.342- 2	7.159- 4
12	7.529- 2	3.458- 2	3.527- 2	8.950- 2	3.826- 2	1.819- 1	2.659- 1	1.207- 1	1.865- 2
13	1.831- 2	7.751- 2	1.248- 2	5.903- 2	5.911- 2	6.577- 2	6.291- 2	2.680- 1	1.453- 1
14	1.214- 3	3.050- 2	6.795- 2	9.790- 4	7.734- 2	3.116- 2	9.074- 2	3.226- 2	2.624- 1
15	2.628- 2	1.321- 3	5.206- 2	4.949- 2	1.953- 3	8.593- 2	1.079- 2	1.091- 1	1.223- 2
16	5.260- 2	1.037- 2	1.007- 2	6.034- 2	2.932- 2	1.263- 2	8.332- 2	8.633- 4	1.146- 1
17	5.928- 2	3.615- 2	1.487- 3	2.347- 2	5.969- 2	1.227- 2	2.857- 2	7.162- 2	1.850- 3
18	5.144- 2	5.183- 2	2.034- 2	5.630- 4	3.691- 2	5.091- 2	2.070- 3	4.458- 2	5.381- 2

Table 55 RKR FRANCK-CONDON FACTORS FOR(CN RED (3/2))

V	VV	0	1	2	3	4	5	6	7	8	9
0		4.922- 1	3.715- 1	1.155- 1	1.911- 2	1.607- 3	5.739- 5	9.733- 7	3.692- 7	1.520- 8	2.726- 3
1		3.287- 1	4.357- 2	3.403- 1	2.239- 1	5.343- 2	5.272- 3	3.297- 4	1.074- 5	1.325- 6	1.919- 9
2		1.256- 1	2.431- 1	1.152- 2	2.139- 1	2.802- 1	1.025- 1	1.530- 2	1.140- 3	4.256- 5	2.163- 6
3		3.868- 2	1.358- 1	1.035- 1	8.785- 2	9.437- 2	2.398- 1	1.355- 1	3.124- 2	2.778- 3	1.190- 4
4		1.083- 2	9.403- 2	1.840- 1	1.586- 2	1.473- 1	1.651- 2	2.558- 1	2.035- 1	5.205- 2	5.654- 3
5		2.915- 3	3.527- 2	1.340- 1	1.258- 1	1.333- 3	1.593- 1	4.310- 4	2.033- 1	2.437- 1	7.815- 2
6		7.584- 4	1.154- 2	6.666- 2	1.432- 1	5.204- 2	2.813- 2	1.298- 1	2.175- 2	1.430- 1	2.671- 1
7		1.948- 4	3.599- 3	2.701- 2	9.436- 2	1.249- 1	1.725- 2	6.538- 2	8.378- 2	5.908- 2	8.219- 2
8		4.956- 5	1.052- 3	9.776- 3	4.787- 2	1.099- 1	9.895- 2	2.794- 4	9.512- 2	3.982- 2	9.658- 2
9		9.537- 6	2.956- 4	3.308- 3	1.994- 2	5.735- 2	1.034- 1	5.617- 2	7.151- 3	1.043- 1	1.037- 2
10		1.772- 6	7.531- 5	1.065- 3	7.659- 3	3.354- 2	9.232- 2	9.455- 2	1.955- 2	2.787- 2	9.436- 2
11		3.258- 7	1.825- 5	3.228- 4	2.777- 3	1.467- 2	4.852- 2	9.317- 2	7.059- 2	2.859- 3	5.137- 2
12		7.821- 8	4.210- 6	9.081- 5	9.548- 4	5.903- 3	2.414- 2	6.205- 2	8.770- 2	4.419- 2	8.277- 4
13		3.229- 8	1.035- 6	2.396- 5	3.089- 4	2.243- 3	1.081- 2	3.517- 2	7.172- 2	7.654- 2	2.114- 2
14		1.896- 8	3.034- 7	6.221- 6	9.269- 5	8.082- 4	4.499- 3	1.753- 2	4.636- 2	7.564- 2	5.924- 2
15		1.034- 8	1.038- 7	1.726- 6	2.593- 5	2.731- 4	1.757- 3	7.982- 3	2.573- 2	5.608- 2	7.281- 2
16		3.723- 9	4.412- 8	5.288- 7	7.054- 6	8.536- 5	5.568- 4	3.434- 3	1.296- 2	3.479- 2	6.255- 2
17		4.587-10	1.592- 8	1.706- 7	1.985- 6	2.458- 5	2.279- 4	1.371- 3	5.946- 3	1.906- 2	4.343- 2
18		6.999-11	3.534- 9	4.907- 8	5.918- 7	6.711- 6	7.295- 5	5.219- 4	2.596- 3	9.559- 3	2.615- 2

Table 55 (cont'd)

(CV RED (3/2))

VV V	10	11	12	13	14	15	16	17	18
0	9.857-10	3.486- 9	3.915-10	1.685- 9	1.209-11	8.845-10	2.431-11	3.035-10	2.032-10
1	1.145- 7	1.753- 3	1.346- 5	7.645- 9	9.657-11	2.019- 9	1.176-11	1.028- 9	1.653-11
2	7.130- 9	8.442- 3	5.935- 8	2.411- 9	2.499- 8	2.303- 9	3.192- 9	1.924- 9	1.600-10
3	4.592- 6	2.180- 9	8.071- 8	6.816- 8	1.451-11	2.534- 8	1.880- 9	8.691-10	5.720- 9
4	2.869- 4	9.517- 6	2.012- 8	8.479- 8	6.331- 9	1.127-11	2.558- 9	1.688- 8	2.070-10
5	1.617- 2	5.924- 4	1.872- 5	7.825- 8	7.198- 8	7.051- 8	4.178-11	3.605- 8	2.644- 8
6	1.082- 1	1.663- 2	1.109- 3	3.602- 5	2.373- 7	5.464- 8	4.251- 9	2.439-10	2.408- 8
7	2.736- 1	1.400- 1	2.531- 2	1.925- 3	6.545- 5	3.928- 7	5.188- 9	4.681- 8	2.053-10
8	3.614- 2	2.637- 1	1.719- 1	3.648- 2	3.139- 3	1.115- 4	8.898- 7	1.415- 8	6.013- 8
9	1.212- 1	8.748- 3	2.434- 1	2.022- 1	5.008- 2	4.791- 3	1.930- 4	1.818- 6	1.556- 9
10	3.442- 5	1.292- 1	6.513- 7	2.072- 1	2.285- 1	6.511- 2	7.120- 3	3.067- 4	3.194- 6
11	7.171- 2	6.699- 3	1.209- 1	7.047- 3	1.679- 1	2.492- 1	8.449- 2	1.018- 2	4.667- 4
12	6.883- 2	4.474- 2	2.425- 2	1.005- 1	2.513- 2	1.268- 1	2.639- 1	1.049- 1	1.402- 2
13	1.026- 2	7.596- 2	2.085- 2	4.650- 2	7.387- 2	4.915- 2	8.797- 2	2.716- 1	1.266- 1
14	5.871- 3	2.578- 2	7.189- 2	5.291- 3	6.627- 2	4.553- 2	7.358- 2	5.481- 2	2.731- 1
15	3.956- 2	7.075- 3	4.182- 2	5.892- 2	2.368- 3	7.952- 2	2.319- 2	9.409- 2	2.975- 2
16	6.396- 2	2.152- 2	3.071- 3	5.372- 2	4.150- 2	4.254- 3	8.399- 2	7.327- 3	1.066- 1
17	6.441- 2	3.850- 2	8.009- 3	1.241- 2	3.880- 2	2.398- 2	1.537- 2	7.960- 2	3.368- 4
18	5.029- 2	3.123- 2	3.492- 2	9.372- 4	2.471- 2	3.535- 2	9.535- 3	2.962- 2	5.810- 2

Table 56

RKR FRANCK-CONDON FACTORS FOR(CN VIOLET)

V\VV	0	1	2	3	4	5	6	7	8	9
0	9.202- 1	7.381- 2	5.536- 3	3.828- 4	2.634- 5	1.116- 6	2.520- 9	7.579- 8	1.178-11	3.403- 8
1	7.958- 2	7.811- 1	1.246- 1	1.434- 2	1.237- 3	9.552- 5	5.456- 6	2.514- 7	4.200- 9	3.962-10
2	1.172- 3	1.424- 1	6.753- 1	1.543- 1	2.393- 2	2.670- 3	2.327- 4	1.534- 5	1.819- 6	6.002- 7
3	1.263- 6	2.650- 3	1.904- 1	5.941- 1	1.739- 1	3.332- 2	4.555- 3	5.417- 4	5.309- 5	7.050- 6
4	8.816- 7	2.597- 5	4.115- 3	2.313- 1	5.291- 1	1.823- 1	4.492- 2	7.036- 3	1.049- 3	1.402- 4
5	1.055- 7	1.709- 6	7.727- 5	5.304- 3	2.662- 1	4.835- 1	1.779- 1	5.526- 2	9.804- 3	1.716- 3
6	1.244- 7	1.233- 7	3.906- 6	2.430- 4	4.976- 2	2.328- 1	4.599- 1	1.638- 1	6.403- 2	1.236- 2
7	8.243- 9	6.648- 9	8.320- 8	1.871- 5	5.933- 4	3.156- 3	3.896- 1	4.558- 1	1.422- 1	7.061- 2
8	7.879- 8	2.507- 8	2.514- 7	3.709- 7	4.179- 5	1.619- 3	8.317- 4	3.122- 1	4.754- 1	1.146- 1
9	1.358- 8	2.763- 8	4.949- 8	3.052- 7	3.406- 6	4.435- 5	3.191- 3	1.538- 4	2.953- 1	5.190- 1
10	5.341- 9	1.850- 7	1.227- 9	4.041- 7	7.297- 9	1.523- 5	1.025- 5	5.010- 3	5.041- 3	2.532- 1
11	1.047- 8	2.359- 8	2.399- 8	2.390- 8	4.638- 7	1.871- 8	4.111- 5	2.174- 5	6.664- 3	2.048- 2
12	6.857-10	6.952- 9	3.511- 8	3.949- 9	1.346- 7	2.514- 9	5.592- 7	6.627- 5	3.395- 4	6.380- 3
13	1.522- 9	2.354- 8	7.378-10	1.102-10	2.873- 8	1.186- 7	1.957- 7	3.535- 6	7.617- 5	1.434- 3
14	1.915- 9	1.289- 8	2.556- 8	3.285-11	1.040- 7	3.879- 9	2.924- 9	4.146- 7	1.632- 5	2.239- 5
15	8.215-11	3.152-10	5.863- 8	1.452- 8	4.653- 8	2.235- 7	1.336- 8	3.870- 7	5.383- 7	5.109- 5
16	6.715-10	1.364- 9	2.629- 8	5.354- 8	1.918- 8	2.315- 7	1.097- 7	1.642- 7	1.247- 6	6.005- 7
17	1.443- 9	1.315- 9	2.863- 9	5.754- 8	3.820- 9	1.142- 7	2.911- 7	2.098- 7	2.809- 7	2.403- 6
18	7.204-10	4.456-11	9.781-10	2.303- 8	4.994- 8	1.837- 8	3.859- 7	2.341- 7	1.467- 7	1.297- 6

Table 56 (cont'd)

(CN VIOLET)

V	VV 10	11	12	13	14	15	16	17	18
0	2.875- 9	5.363- 9	2.151-10	6.289-11	1.038-10	3.534-11	9.761-10	1.965- 9	1.282- 9
1	7.851- 8	1.855- 7	9.663- 8	6.497- 9	5.969- 9	1.318- 8	7.634- 9	3.489- 9	2.302- 9
2	2.453- 7	1.837- 7	2.225- 7	1.550- 7	2.154- 9	1.471- 8	5.938- 9	6.295- 8	2.446- 8
3	2.651- 6	1.336- 6	5.074- 7	1.849- 7	5.301- 8	1.591- 9	3.935- 9	1.320- 7	1.431- 7
4	2.664- 5	5.899- 5	2.627- 6	7.979- 7	9.507- 9	1.555-10	3.741- 8	1.161- 7	1.869- 7
5	2.763- 4	4.448- 5	9.053- 6	3.029- 6	8.869- 7	1.481- 8	1.855- 7	1.958- 7	2.106- 7
6	2.438- 3	4.266- 4	7.418- 5	1.184- 5	2.227- 5	4.937- 7	5.513-10	3.872- 7	5.515- 7
7	1.405- 2	3.132- 3	5.511- 4	9.834- 5	1.541- 5	1.623- 6	5.517- 9	3.343- 9	2.829- 7
8	7.637- 2	1.443- 2	3.716- 3	6.590- 4	1.138- 4	1.511- 5	1.570- 5	2.447- 9	1.943- 7
9	8.148- 2	8.234- 2	1.342- 2	4.122- 3	7.118- 4	1.315- 4	1.695- 5	1.211- 6	4.893-11
10	5.811- 1	4.915- 2	9.001- 2	1.107- 2	4.537- 3	7.830- 4	1.416- 4	1.917- 5	1.826- 6
11	1.890- 1	6.456- 1	2.231- 2	1.022- 1	7.776- 3	5.058- 3	6.593- 4	1.633- 4	1.732- 5
12	4.820- 2	1.126- 1	6.974- 1	4.774- 3	1.194- 1	4.163- 3	5.942- 3	5.026- 4	2.054- 4
13	3.656- 3	8.537- 2	4.234- 2	7.135- 1	8.695- 5	1.448- 1	9.056- 4	7.774- 3	2.847- 4
14	3.358- 3	3.491- 4	1.202- 1	2.452- 3	6.766- 1	7.355- 3	1.779- 1	2.534- 4	1.094- 2
15	3.050- 5	5.468- 3	2.219- 3	1.375- 1	1.626- 2	5.789- 1	2.127- 2	2.166- 1	4.864- 3
16	7.481- 5	5.115- 4	5.615- 3	1.613- 2	1.229- 1	9.263- 2	4.316- 1	3.206- 2	2.552- 1
17	1.244- 5	4.596- 5	1.993- 3	2.921- 3	4.471- 2	7.534- 2	2.105- 1	2.690- 1	3.167- 2
18	6.677- 7	5.041- 5	6.882- 6	3.993- 3	5.681- 5	7.876- 2	2.233- 2	3.233- 1	1.280- 1

Table 57

RKR FRANCK-CONDON FACTORS FOR(CO 4TH +)

V	V' 0	1	2	3	4	5	6	7	8	9	10	11	12
-	1.111-1	2.600-1	2.905-1	1.396-1	3.708-2	3.415-2	9.172-3	2.837-3	3.939-4	5.474-5	7.798-6	4.098-7	5.2[illegible]-[illegible]
1	2.188-1	1.553-1	2.352-3	7.789-2	1.979-1	1.859-1	1.040-1	4.355-2	1.218-2	2.905-3	5.395-4	9.137-5	1.231-5
2	2.378-1	1.134-2	9.147-2	1.123-1	3.358-3	6.526-2	1.717-1	1.541-1	9.293-2	3.651-2	1.088-2	2.582-3	5.142-4
3	1.943-1	2.357-2	1.150-1	1.413-4	9.439-2	7.748-2	1.763-5	7.951-2	1.653-1	1.434-1	7.519-2	2.916-2	9.453-3
4	1.174-1	9.359-2	3.029-2	6.218-2	6.057-2	1.051-2	1.021-1	4.254-2	6.994-3	1.330-1	1.585-1	1.2[illegible]-1	5.099-2
5	6.620-2	1.243-1	1.249-3	9.022-2	3.026-4	8.596-2	1.578-2	4.135-2	9.365-2	1.348-2	2.776-2	1.216-1	1.470-1
6	3.443-2	1.182-1	3.334-2	3.594-2	4.947-2	3.460-2	3.013-2	6.748-2	1.213-4	7.480-2	6.488-2	2.050-4	5.690-2
7	1.687-2	8.725-2	8.273-2	5.700-4	7.353-2	1.422-3	6.964-2	3.213-4	6.575-2	2.717-2	1.950-2	3.624-2	2.997-2
8	7.905-3	5.572-2	9.756-2	1.519-2	3.722-2	4.174-2	2.07[illegible]-2	4.877-2	3.246-2	1.961-2	6.633-2	1.299-3	5.311-2
9	3.502-3	3.190-2	8.595-2	5.144-2	3.219-3	5.147-2	2.104-3	5.563-2	2.334-3	5.999-2	9.029-4	5.523-2	5.303-2
10	1.531-3	1.730-2	6.420-2	7.456-2	5.849-3	3.613-2	3.392-2	1.425-2	4.248-2	1.309-2	3.747-2	3.130-2	1.300-2
11	6.563-4	5.993-3	4.319-2	7.783-2	3.148-2	6.434-3	5.283-2	1.781-3	4.537-2	5.906-3	4.529-2	3.100-3	5.448-2
12	2.718-4	4.471-3	2.656-2	6.603-2	5.528-2	1.393-3	3.513-2	2.541-2	1.134-2	4.805-2	4.765-3	4.215-2	9.855-3
13	1.107-4	2.188-3	1.557-2	4.384-2	6.608-2	1.801-2	9.878-3	4.363-2	1.811-3	3.835-2	9.659-3	3.313-2	1.02[illegible]-2
14	4.314-5	1.029-3	9.392-3	3.394-2	6.288-2	3.957-2	1.889-5	3.420-2	1.958-2	1.867-2	3.652-2	2.01[illegible]-3	4.817-2
15	1.635-5	4.706-4	4.549-3	2.155-2	5.183-2	5.375-2	8.912-3	1.343-2	3.573-2	2.648-4	3.397-2	9.700-3	2.541-2
16	6.082-6	2.083-4	2.318-3	1.294-2	3.858-2	5.674-2	2.613-2	8.579-4	3.229-2	1.296-2	1.149-2	3.145-2	1.399-3
17	2.272-6	8.914-5	1.146-3	7.476-3	2.678-2	5.147-2	4.119-2	2.871-3	1.698-2	2.752-2	3.794-5	3.118-2	7.256-3
18	8.597-7	3.615-5	5.470-4	4.154-3	1.758-2	4.197-2	4.869-2	1.458-2	3.561-3	2.912-2	6.684-3	1.393-2	2.491-2
19	3.251-7	1.346-5	2.493-4	2.234-3	1.098-2	3.146-2	4.823-2	2.783-2	1.554-4	1.927-2	1.854-2	1.26[illegible]-3	2.819-2
20	1.152-7	4.333-6	1.056-4	1.125-3	6.416-3	2.155-2	4.118-2	3.356-2	5.293-3	7.398-3	2.278-2	1.569-3	1.602-2

Table 57 (cont'd)

(CO 4T4. +)

V	VV 13	14	15	16	17	18	19	20	21	22	23	24
0	8.841- 8	2.942- 8	1.339- 8	5.853-10	1.425- 9	1.838- 9	1.175-10	5.411-11	1.214-10	5.537-12	3.696-12	1.221-10
1	2.896- 6	3.797- 7	3.562- 9	4.042- 8	2.534- 8	1.130- 8	3.691- 9	4.696-10	3.893-13	2.831- 9	5.262- 9	1.750-10
2	9.685- 5	1.514- 5	1.832- 6	8.523-10	1.287- 8	3.429- 8	5.712- 9	2.447- 8	1.565- 8	1.307- 8	1.897-11	4.788-10
3	2.162- 3	4.266- 4	6.231- 5	3.944- 6	2.258- 7	3.884- 7	1.848- 7	5.799-10	7.912- 8	1.127-11	5.376- 9	9.719- 9
4	2.298- 2	6.476- 3	1.372- 3	2.258- 4	3.812- 5	5.531- 6	1.887- 6	7.953- 8	1.079- 7	1.424- 9	3.038- 8	2.050- 8
5	1.886- 1	4.633- 2	1.555- 2	3.994- 3	8.381- 4	1.555- 4	2.723- 5	3.959- 6	3.393- 8	1.324- 7	2.549- 9	1.352- 7
6	1.362- 1	1.322- 1	7.948- 2	3.265- 2	1.031- 2	2.826- 3	5.467- 4	8.893- 5	9.423- 6	2.809- 7	4.628- 8	3.395- 7
7	7.496- 3	8.896- 2	1.402- 1	1.121- 1	5.895- 2	2.274- 2	5.574- 3	1.498- 3	2.634- 4	3.728- 5	4.809- 6	1.076- 5
8	7.177- 2	5.293- 3	3.216- 2	1.141- 1	1.333- 1	9.122- 2	4.238- 2	1.438- 2	3.822- 3	8.201- 4	1.402- 4	2.011- 5
9	9.980- 3	7.634- 2	4.147- 2	9.498- 4	5.489- 2	1.332- 1	1.205- 1	5.959- 2	2.982- 2	9.224- 3	2.234- 3	4.335- 4
10	6.209- 2	4.521- 3	3.844- 2	7.322- 2	1.352- 2	1.635- 2	9.599- 2	1.325- 1	1.809- 1	5.144- 2	1.964- 2	5.398- 3
11	1.918- 3	4.598- 2	3.781- 2	3.193- 3	6.457- 2	5.858- 2	2.885- 4	4.339- 2	1.183- 1	1.242- 1	7.929- 2	3.592- 2
12	3.383- 2	3.882- 2	9.114- 3	5.814- 2	8.911- 3	2.977- 2	7.145- 2	2.226- 2	7.826- 3	7.875- 2	1.388- 1	1.114- 1
13	3.909- 2	2.981- 3	5.836- 2	3.244- 3	3.718- 2	4.158- 2	4.118- 4	5.341- 2	5.762- 2	3.236- 3	3.125- 2	1.195- 1
14	1.925- 3	3.985- 2	8.245- 3	2.995- 2	3.114- 2	5.898- 3	5.407- 2	1.425- 2	1.624- 2	6.864- 2	3.886- 2	2.824- 3
15	1.468- 2	2.562- 2	1.193- 2	3.576- 2	2.144- 3	4.298- 2	5.363- 3	2.927- 2	4.455- 2	1.776- 4	4.317- 2	6.840- 2
16	3.547- 2	1.644- 4	3.737- 2	1.885- 3	3.674- 2	8.988- 3	2.424- 2	3.279- 2	1.918- 3	4.878- 2	2.852- 2	9.876- 3
17	2.138- 2	1.481- 2	1.785- 2	1.632- 2	2.266- 2	9.938- 3	3.374- 2	7.124- 4	4.148- 2	9.489- 3	1.993- 2	4.598- 2
18	1.892- 3	3.833- 2	1.918- 5	3.228- 2	1.412- 5	3.371- 2	1.454- 3	3.121- 2	1.203- 2	1.663- 2	3.582- 2	4.959- 3
19	3.751- 3	2.812- 2	1.156- 2	1.498- 2	1.513- 2	1.581- 2	1.331- 2	2.248- 2	5.577- 3	3.358- 2	7.435- 5	3.392- 2
20	1.616- 2	3.841- 3	2.352- 2	3.878- 4	2.596- 2	2.239- 5	2.731- 2	3.782- 4	2.722- 2	4.389- 3	2.134- 2	1.781- 2

Table 58

RKR FRANCK-CONDON FACTORS FOR (N(2) 1ST.+)

VV V	0	1	2	3	4	5	6
0	4.003- 1	3.304- 1	1.662- 1	6.681- 2	2.384- 2	7.968- 3	2.577- 3
1	3.990- 1	2.383- 3	1.589- 1	1.963- 1	1.303- 1	5.555- 2	2.838- 2
2	1.616- 1	2.743- 1	6.860- 2	2.205- 2	1.245- 1	1.427- 1	1.039- 1
3	3.411- 2	2.767- 1	9.595- 2	1.515- 1	5.131- 3	4.233- 2	1.077- 1
4	4.810- 3	9.592- 2	2.973- 1	7.555- 3	1.510- 1	5.114- 2	2.211- 3
5	2.665- 4	1.628- 2	1.688- 1	2.431- 1	1.046- 2	9.528- 2	9.404- 2
6	1.088- 5	1.424- 3	3.893- 2	2.295- 1	1.553- 1	5.803- 2	3.534- 2
7	2.527- 7	6.538- 5	4.337- 3	7.163- 2	2.655- 1	7.447- 2	1.056- 1
8	3.912- 9	1.398- 6	2.337- 4	9.882- 3	1.113- 1	2.712- 1	2.005- 2
9	2.559-10	3.579-11	5.539- 6	6.303- 4	1.899- 2	1.554- 1	2.487- 1
10	3.150- 9	1.243-12	1.357- 4	1.660- 5	1.420- 3	3.235- 2	1.975- 1
11	3.231-10	2.490- 9	3.377-12	8.925- 5	4.230- 5	2.829- 3	5.036- 2
12	4.427-10	1.135- 9	2.924- 9	9.562-10	3.510- 7	9.730- 5	5.100- 3
13	5.016-10	7.532-11	6.955-10	2.820- 9	3.225- 9	8.540- 7	1.966- 4
14	4.800-12	8.491-10	1.181-10	1.285- 9	7.428-11	2.588- 9	1.814- 6
15	1.209-10	3.364-10	6.717-10	4.387-10	1.503- 9	2.621-10	4.156- 9
16	7.521-11	1.826-11	5.034-10	1.400- 9	5.541-13	3.090-10	5.698-10
17	1.011-14	2.320-10	4.560-11	3.595-10	1.507- 9	1.312-10	2.796-10

Table 58 (cont'd)

(V(2) 1ST.+)

V	VV 7	8	9	10	11	12	13
0	8.221- 4	2.611- 4	8.295- 5	2.645- 5	8.524- 5	2.811- 5	9.655- 7
1	1.127- 2	4.262- 3	1.572- 3	5.745- 4	2.091- 4	7.602- 5	2.778- 5
2	5.617- 2	2.722- 2	1.214- 2	5.159- 3	2.138- 3	8.665- 4	3.439- 4
3	1.114- 1	8.886- 2	4.727- 2	2.482- 2	1.209- 2	5.513- 3	2.532- 3
4	5.469- 2	9.391- 2	8.975- 2	6.589- 2	4.817- 2	2.239- 2	1.168- 2
5	8.739- 3	1.404- 2	5.955- 2	8.133- 2	7.392- 2	5.398- 2	3.450- 2
6	1.843- 1	3.935- 2	5.372- 7	2.511- 2	5.933- 2	7.118- 2	6.154- 2
7	3.054- 3	8.142- 2	6.755- 2	1.864- 2	3.895- 3	3.178- 2	5.497- 2
8	1.280- 1	4.732- 3	4.454- 2	7.713- 2	3.312- 2	1.012- 3	9.868- 3
9	1.909- 4	1.199- 1	2.917- 2	1.356- 2	5.595- 2	5.280- 2	1.292- 2
10	2.054- 1	1.822- 2	8.952- 2	5.892- 2	2.618- 4	4.208- 2	5.956- 2
11	2.334- 1	1.514- 1	3.875- 2	5.163- 2	7.911- 2	6.808- 3	1.758- 2
12	7.292- 2	2.591- 1	9.664- 2	7.263- 2	1.961- 2	8.245- 2	2.413- 2
13	8.519- 3	9.348- 2	2.722- 1	5.803- 2	1.802- 1	2.209- 3	6.938- 2
14	3.665- 4	1.341- 2	1.294- 1	2.712- 1	1.757- 2	1.142- 1	1.913- 3
15	3.597- 6	6.387- 4	2.808- 2	1.611- 1	2.370- 1	1.750- 3	1.121- 1
16	3.126- 9	6.543- 6	1.858- 3	2.873- 2	1.933- 1	2.316- 1	1.996- 3
17	1.417- 9	3.135-12	1.855- 5	1.622- 3	3.958- 2	2.258- 1	1.987- 1

Table 59 RKR FRANCK-CONDON FACTORS FOR (N(2) 2N).+)

V' \ V	0	1	2	3	4	5	6	7	8
0	4.524- 1	3.272- 1	1.454- 1	5.162- 2	1.606- 2	4.522- 3	1.256- 3	3.348- 4	9.630- 5
1	3.925- 1	2.177- 2	2.036- 1	1.983- 1	1.134- 1	4.712- 2	1.729- 2	5.769- 3	1.859- 3
2	1.331- 1	3.415- 1	2.420- 2	6.317- 2	1.634- 1	1.387- 1	7.929- 2	3.632- 2	1.454- 2
3	2.043- 2	2.330- 1	2.102- 1	8.923- 2	4.734- 3	9.316- 2	1.303- 1	9.865- 2	5.550- 2
4	9.693- 4	5.384- 2	3.307- 1	1.199- 1	1.131- 1	3.915- 3	4.031- 2	1.001- 1	1.031- 1

V' \ V	9	10	11	12	13	14	15	16	17
0	2.180- 5	5.433- 6	1.354- 6	3.454- 7	9.229- 8	2.530- 8	7.954- 9	2.487- 9	7.397-10
1	5.436- 4	1.584- 4	4.512- 5	1.268- 5	3.563- 6	1.023- 6	3.033- 7	9.163- 8	2.642- 8
2	5.328- 3	1.836- 3	6.070- 4	1.951- 4	6.138- 5	1.893- 5	5.756- 6	1.740- 6	5.121- 7
3	2.628- 2	1.111- 2	4.344- 3	1.606- 3	5.719- 4	1.975- 4	6.656- 5	2.169- 5	6.740- 6
4	6.802- 2	3.736- 2	1.736- 2	7.870- 3	3.217- 3	1.248- 3	4.650- 4	1.687- 4	5.943- 5

Table 60 RKR FRANCK-CONDON FACTORS FOR(N2 B-H 1)

V'V	0	1	2	3	4	5	6	7	8	9	10
0	2.753- 7	3.797- 6	2.719- 5	2.719- 5	5.022- 4	1.540- 3	3.989- 3	8.925- 3	1.756- 2	3.083- 2	4.858- 2
1	3.751- 6	4.532- 5	2.822- 4	2.822- 4	3.819- 3	9.808- 3	2.085- 2	3.736- 2	5.703- 2	7.440- 2	8.209- 2
2	2.592- 5	2.723- 4	1.461- 3	1.461- 3	1.404- 2	2.939- 2	4.944- 2	6.693- 2	7.223- 2	5.937- 2	3.285- 2
3	1.212- 4	1.097- 3	5.012- 3	5.012- 3	3.283- 2	5.408- 2	6.741- 2	6.151- 2	3.658- 2	9.133- 3	4.161- 4
4	4.314- 4	3.331- 3	1.277- 2	1.277- 2	5.384- 2	6.533- 2	5.330- 2	2.351- 2	1.482- 3	7.062- 3	3.115- 2
5	1.247- 3	8.108- 3	2.562- 2	2.562- 2	6.383- 2	5.874- 2	1.898- 2	1.237- 4	1.291- 2	3.649- 2	3.627- 2
6	3.049- 3	1.645- 2	4.188- 2	4.188- 2	5.373- 2	2.864- 2	9.846- 5	1.453- 2	3.689- 2	3.806- 2	5.350- 3
7	6.493- 3	2.855- 2	5.674- 2	5.674- 2	2.847- 2	9.719- 4	1.218- 2	3.558- 2	2.768- 2	3.176- 3	6.612- 3
8	1.228- 2	4.306- 2	6.390- 2	6.390- 2	5.638- 3	6.534- 3	3.259- 2	2.911- 2	3.606- 3	6.833- 3	2.888- 2
9	2.098- 2	5.688- 2	5.989- 2	5.989- 2	8.089- 4	2.591- 2	3.292- 2	5.723- 3	4.519- 3	2.709- 2	2.102- 2
10	3.279- 2	6.606- 2	4.312- 2	4.312- 2	1.402- 2	3.553- 2	1.393- 2	1.182- 3	2.346- 2	2.298- 2	1.202- 3
11	4.729- 2	6.725- 2	2.222- 2	2.222- 2	3.853- 2	2.524- 2	2.998- 4	1.662- 2	2.618- 2	3.602- 3	7.752- 3
12	6.331- 2	5.889- 2	5.482- 3	5.482- 3	3.456- 2	7.168- 3	6.874- 3	2.746- 2	9.322- 3	3.103- 3	2.332- 2
13	7.988- 2	4.273- 2	5.620- 5	5.620- 5	2.318- 2	8.702- 5	2.288- 2	1.839- 2	4.588- 5	1.854- 2	1.698- 2
14	9.239- 2	2.355- 2	7.135- 3	7.135- 3	7.863- 3	9.088- 3	2.595- 2	3.152- 3	1.885- 2	2.160- 2	1.758- 3
15	1.017- 1	7.493- 3	2.158- 2	2.158- 2	5.962- 8	2.231- 2	1.460- 2	1.547- 3	2.168- 2	8.109- 3	3.826- 3
16	1.047- 1	1.142- 4	3.454- 2	3.454- 2	6.511- 3	2.537- 2	1.917- 3	1.338- 2	1.738- 2	1.607- 5	1.673- 2
17	1.003- 1	4.477- 3	3.821- 2	3.821- 2	1.907- 2	1.558- 2	1.832- 3	2.135- 2	4.219- 3	8.262- 3	1.726- 2
18	8.919- 2	1.915- 2	3.864- 2	3.864- 2	2.567- 2	3.358- 3	1.232- 2	1.579- 2	5.618- 4	1.888- 2	5.366- 3
19	7.193- 2	3.759- 2	1.644- 2	1.644- 2	2.855- 2	3.512- 4	1.956- 2	4.186- 3	8.853- 3	1.452- 2	1.392- 4
20	1.534- 2	1.766- 2	7.272- 4	7.272- 4	2.188- 3	2.975- 3	4.351- 3	2.658- 4	5.182- 3	6.166- 4	2.988- 3

Table 60 (cont'd)

RKR FRANCK-CONDON FACTORS FOR(V2 3-H 1)

V' \ V	11	12	13	14	15	16	17	18	19	20	21
0	6.934- 2	9.611- 2	1.068- 1	1.102- 1	1.162- 1	1.004- 1	8.976- 2	6.972- 2	5.005- 2	3.316- 2	2.012- 2
1	7.515- 2	5.404- 2	2.685- 2	5.341- 3	5.599- 4	1.446- 2	4.135- 2	6.975- 2	8.914- 2	9.403- 2	8.493- 2
2	7.815- 3	3.995- 4	1.530- 2	4.080- 2	5.696- 2	5.062- 2	2.720- 2	4.977- 3	1.586- 3	2.161- 2	5.517- 2
3	1.663- 2	4.061- 2	4.726- 2	2.943- 2	5.803- 3	1.757- 3	2.223- 2	4.635- 2	4.971- 2	2.892- 2	4.729- 3
4	4.334- 2	2.802- 2	4.550- 3	3.199- 3	2.558- 2	4.208- 2	3.030- 2	6.757- 3	1.812- 3	2.420- 2	4.756- 2
5	1.246- 2	1.701- 4	1.712- 2	3.052- 2	2.801- 2	4.825- 3	3.566- 3	2.697- 2	3.929- 2	2.164- 2	8.809- 4
6	3.652- 3	2.620- 2	3.264- 2	1.158- 2	4.190- 4	1.914- 2	3.453- 2	1.913- 2	3.786- 4	1.246- 2	3.569- 2
7	2.903- 2	2.600- 2	3.552- 3	5.739- 3	2.778- 2	2.565- 2	3.600- 3	5.771- 3	2.866- 2	2.732- 2	4.027- 3
8	2.183- 2	1.024- 3	1.056- 2	2.865- 2	1.593- 2	2.013-10	1.633- 2	2.934- 2	1.096- 2	9.835- 4	2.233- 2
9	5.996- 4	1.233- 2	2.744- 2	1.031- 2	1.231- 3	2.143- 2	2.328- 2	2.398- 3	8.264- 3	2.781- 2	1.489- 2
10	1.119- 2	2.619- 2	8.346- 3	2.448- 3	2.273- 2	1.787- 2	1.374- 4	1.440- 2	2.212- 2	5.270- 3	5.238- 3
11	2.520- 2	9.065- 3	2.237- 3	2.200- 2	1.522- 2	3.521- 5	1.536- 2	2.091- 2	1.326- 3	1.077- 2	2.444- 2
12	1.208- 2	9.414- 4	1.996- 2	1.513- 2	4.337- 5	1.679- 2	1.821- 2	3.197- 4	1.350- 2	2.111- 2	1.669- 3
13	2.205- 7	1.630- 2	1.689- 2	5.007- 5	1.474- 2	1.748- 2	2.356- 4	1.354- 2	1.857- 2	5.739- 4	1.273- 2
14	1.057- 2	1.937- 2	1.133- 3	1.101- 2	1.821- 2	7.190- 4	1.175- 2	1.752- 2	4.654- 4	1.267- 2	1.720- 2
15	2.035- 2	4.592- 3	5.129- 3	1.902- 2	2.413- 3	8.475- 3	1.791- 2	9.891- 4	1.098- 2	1.654- 2	1.550- 4
16	1.090- 2	1.459- 3	1.815- 2	6.847- 3	4.310- 3	1.802- 2	2.534- 3	8.830- 3	1.670- 2	5.206- 4	1.215- 2
17	2.268- 4	1.355- 2	1.160- 2	7.776- 4	1.658- 2	5.979- 3	4.154- 3	1.732- 2	1.794- 3	9.198- 3	1.452- 2
18	5.753- 3	1.633- 2	4.633- 4	1.203- 2	1.885- 2	8.103- 4	1.572- 2	4.758- 3	5.251- 3	1.557- 2	5.107- 4
19	1.515- 2	5.476- 3	4.670- 3	1.481- 2	3.578- 4	1.131- 2	9.149- 3	1.298- 3	1.494- 2	2.747- 3	7.241- 3
20	3.199- 3	2.906- 4	4.360- 3	7.142- 4	2.296- 3	3.353- 3	8.898- 5	4.808- 3	1.153- 3	1.667- 3	3.738- 3

Table 61

RKR FRANCK-CONDON FACTORS FOR(N2 B-H 2)

V' \ V	0	1	2	3	4	5	6	7	8	9	10
0	1.155- 2	3.588- 2	6.628- 2	6.628- 2	1.176- 1	1.280- 1	1.261- 1	1.136- 1	9.436- 2	7.296- 2	5.260- 2
1	4.793- 2	1.023- 1	1.193- 1	1.193- 1	5.405- 2	1.611- 2	1.351- 4	9.526- 3	3.562- 2	6.469- 2	8.504- 2
2	1.011- 1	1.311- 1	7.081- 2	7.081- 2	3.826- 3	3.347- 2	5.369- 2	6.554- 2	4.082- 2	1.172- 2	1.251- 5
3	1.436- 1	9.025- 2	5.462- 3	5.462- 3	6.821- 2	6.833- 2	2.372- 2	2.538- 4	1.428- 2	4.531- 2	5.970- 2
4	1.598- 1	2.943- 2	1.538- 2	1.538- 2	4.735- 2	4.358- 3	1.851- 2	4.496- 2	5.029- 2	2.125- 2	2.079- 4
5	1.506- 1	3.666- 4	6.409- 2	6.409- 2	1.605- 3	2.221- 2	5.228- 2	2.997- 2	7.897- 4	1.532- 2	4.446- 2
6	1.233- 1	1.425- 2	8.804- 2	8.804- 2	2.862- 2	5.258- 2	1.914- 2	1.436- 3	3.220- 2	4.222- 2	1.258- 2
7	9.122- 2	4.874- 2	5.222- 2	5.222- 2	5.379- 2	2.245- 2	2.471- 3	3.654- 2	3.327- 2	2.078- 3	1.360- 2
8	6.284- 2	7.858- 2	1.587- 2	1.587- 2	4.151- 2	6.078- 5	3.415- 2	3.159- 2	5.173- 4	2.838- 2	3.695- 2
9	4.078- 2	9.103- 2	1.109- 4	1.109- 4	9.248- 3	2.119- 2	3.833- 2	1.828- 3	1.888- 2	3.405- 2	5.255- 3
10	2.558- 2	8.757- 2	8.328- 3	8.328- 3	1.883- 3	4.260- 2	1.116- 2	1.858- 2	3.431- 2	6.533- 3	8.885- 3
11	1.573- 2	7.477- 2	2.793- 2	2.793- 2	1.948- 2	3.444- 2	4.308- 4	3.221- 2	1.489- 2	4.137- 3	2.941- 2
12	9.629- 3	5.923- 2	4.644- 2	4.644- 2	4.887- 2	1.206- 2	1.574- 2	2.846- 2	3.559- 7	2.433- 2	1.683- 2
13	5.867- 3	4.426- 2	5.718- 2	5.718- 2	4.798- 2	1.597- 4	3.172- 2	8.975- 3	1.132- 2	2.539- 2	3.981- 4
14	3.619- 3	3.208- 2	5.968- 2	5.968- 2	3.976- 2	5.998- 3	3.185- 2	2.547- 6	2.562- 2	8.856- 3	7.538- 3
15	2.253- 3	2.270- 2	5.589- 2	5.589- 2	2.445- 2	2.892- 2	1.755- 2	7.602- 3	2.416- 2	1.071- 6	2.118- 2
16	1.424- 3	1.588- 2	4.883- 2	4.883- 2	1.848- 2	3.357- 2	4.534- 3	2.029- 2	1.153- 2	6.681- 3	2.188- 2
17	9.126- 4	1.183- 2	4.053- 2	4.053- 2	2.281- 3	3.795- 2	9.582- 6	2.628- 2	1.462- 3	1.744- 2	9.754- 3
18	5.977- 4	7.788- 3	3.266- 2	3.265- 2	1.318- 5	3.445- 2	4.357- 3	2.238- 2	9.838- 4	2.096- 2	9.815- 4
19	3.965- 4	5.376- 3	2.561- 2	2.561- 2	2.114- 3	2.614- 2	1.318- 2	1.486- 2	7.678- 3	1.571- 2	1.255- 3
20	2.672- 4	3.775- 3	1.974- 2	1.974- 2	6.158- 3	1.695- 2	2.125- 2	5.555- 3	1.527- 2	7.319- 3	7.418- 3
21	1.759- 4	2.569- 3	1.445- 2	1.445- 2	9.769- 3	8.823- 3	2.474- 2	8.124- 4	1.837- 2	1.433- 3	1.247- 2
22	9.437- 5	1.411- 3	8.356- 3	8.356- 3	9.818- 3	3.248- 3	1.864- 2	3.134- 5	1.329- 2	7.765- 9	1.032- 2
23	4.823- 5	7.424- 4	4.657- 3	4.657- 3	8.255- 3	5.845- 4	1.313- 2	1.306- 3	8.095- 3	1.179- 3	6.794- 3
24	3.188- 5	5.607- 4	3.268- 3	3.268- 3	7.895- 3	3.632- 5	1.816- 2	2.806- 3	5.108- 3	2.755- 3	4.244- 3

Table 6I (cont'd)

RKR FRANCK-CONDON FACTORS FOR(N2 B-H 21)

V'V	11	12	13	14	15	16	17	18	19	20	21
0	3.547- 2	2.241- 2	1.323- 2	7.3[illegible]- 3	3.753- 3	1.791- 3	7.778- 4	3.135- [illegible]	1.157- [illegible]	3.931- 5	1.227- [illegible]
1	9.138- 2	8.454- 2	6.911- 2	5.052- 2	3.335- 2	1.986- 2	1.072- 2	5.245- 3	2.338- 3	9.482- 4	3.436- 4
2	1.256- 2	4.648- 2	6.802- 2	8.317- 2	8.210- 2	6.826- 2	4.917- 2	3.109- 2	1.744- 2	8.720- 3	3.844- 3
3	4.249- 2	1.425- 2	3.291- 5	1.189- 2	4.142- 2	6.997- 2	8.290- 2	7.748- 2	6.021- 2	3.995- 2	2.263- 2
4	1.414- 2	4.309- 2	5.324- 2	3.337- 2	6.801- 3	1.641- 3	2.433- 2	5.804- 2	9.098- 2	8.293- 2	6.710- 2
5	4.002- 2	1.049- 2	1.305- 3	2.545- 2	4.999- 2	4.344- 2	1.535- 2	4.719- 7	1.066- 2	5.307- 2	8.247- 2
6	1.559- 3	2.805- 2	4.355- 2	2.202- 2	3.749- 4	1.426- 2	4.355- 2	4.651- 2	1.981- 2	1.525- [illegible]	1.645- 2
7	3.931- 2	2.445- 2	4.797- [illegible]	1.532- 2	4.004- 2	2.897- 2	2.593- 3	8.740- 3	3.908- 2	4.653- 2	1.954- 2
8	9.723- 3	3.764- 3	3.128- 2	3.041- 2	3.575- 3	8.396- 3	3.581- 2	3.154- 2	4.368- 3	7.133- 3	3.857- 2
9	9.273- 3	3.355- 2	1.650- 2	4.346- [illegible]	2.398- 2	3.197- 2	6.537- 3	5.141- 3	3.254- 2	3.134- 2	4.801- 3
10	3.200- 2	1.067- 2	3.296- 3	2.828- 2	2.060- 2	3.198- 5	1.858- 2	3.150- 2	8.198- 3	4.017- 3	3.136- 2
11	1.141- 2	3.528- 3	2.748- 2	1.467- 2	8.253- 4	2.373- 2	2.231- 2	4.903- [illegible]	1.534- 2	3.053- 2	7.971- 3
12	1.005- 3	2.472- 2	1.475- 2	1.003- 3	2.309- 2	1.716- 2	1.322- [illegible]	2.025- 2	2.272- 2	8.691- 4	1.436- 2
13	1.794- 2	1.885- 2	5.591- 5	1.397- 2	1.650- 2	1.293- [illegible]	1.977- 2	1.809- 2	1.189- 6	1.802- 2	2.180- 2
14	2.312- 2	1.568- 3	1.348- 2	1.951- 2	1.152- [illegible]	1.612- 2	1.751- 2	3.539- 6	1.732- 2	1.810- 2	2.289- 5
15	9.350- 3	4.478- 3	2.164- 2	2.830- 3	1.016- 2	1.914- 2	5.899- [illegible]	1.350- 2	1.777- 2	7.222- 5	1.580- 2
16	6.521- 5	1.710- 2	1.051- 2	2.624- 3	1.999- 2	3.832- 3	7.534- 3	1.882- 2	1.056- 3	1.202- 2	1.703- 2
17	5.417- 3	1.845- 2	3.751- [illegible]	1.424- 2	1.126- 2	1.561- 3	1.804- 2	4.755- 3	6.068- 3	1.821- 2	1.192- 3
18	1.534- 2	8.868- 3	3.738- 3	1.717- 2	8.312- [illegible]	1.221- 2	1.143- 2	8.355- [illegible]	1.668- 2	5.285- 3	5.360- 3
19	1.834- 2	8.582- [illegible]	1.256- 2	8.972- 3	2.499- 3	1.618- 2	1.209- 3	1.019- 2	1.154- 2	4.736- [illegible]	1.562- 2
20	1.317- 2	1.215- 3	1.561- 2	1.152- 3	1.032- 2	9.240- 3	1.720- 3	1.475- 2	1.654- 3	8.662- 3	1.136- 2
21	5.470- 3	6.426- 3	1.085- 2	6.449- [illegible]	1.305- 2	1.653- 3	8.201- 3	8.907- 3	9.133- [illegible]	1.297- 2	2.814- 3
22	9.571- [illegible]	7.715- 3	4.019- 3	3.037- 3	7.816- 3	3.778- 5	8.458- 3	2.113- 3	4.653- 3	7.149- 3	1.898- [illegible]
23	1.146- [illegible]	6.916- 3	3.178- [illegible]	5.265- 3	2.425- 3	2.894- 3	5.337- 3	5.297- 5	5.886- 3	1.279- 3	3.824- 3
24	1.148- 3	5.218- 3	1.166- [illegible]	5.298- 3	3.688- [illegible]	3.788- 3	2.431- 3	1.374- 3	4.595- 3	8.487- 7	4.585- 3

Table 62

RKR FRANCK-CONDON FACTORS FOR(N2+ MEINEL)

V V	0	1	2	3	4	5	6	7	8	9	10
0	5.106- 1	3.646- 1	1.062- 1	1.652- 2	1.487- 3	7.818- 5	2.253- 6	1.923- 8	2.833-10	1.398-12	3.498-11
1	3.160- 1	5.256- 2	3.531- 1	2.177- 1	5.386- 2	6.568- 3	4.344- 4	1.439- 5	1.548- 7	3.846-11	2.617-10
2	1.239- 1	2.454- 1	1.034- 2	2.156- 1	2.849- 1	1.042- 1	1.766- 2	1.387- 3	5.305- 5	6.712- 7	1.481-10
3	3.753- 2	1.920- 1	1.429- 1	8.883- 2	8.504- 2	2.953- 1	1.504- 1	3.407- 2	3.349- 3	1.469- 4	2.066- 6
4	1.034- 2	9.196- 2	1.817- 1	1.552- 2	1.515- 1	1.316- 2	2.596- 1	2.118- 1	5.768- 2	6.769- 3	3.366- 4
5	2.840- 3	3.522- 2	1.328- 1	1.218- 1	2.726- 3	1.592- 1	2.887- 3	1.945- 1	2.501- 1	9.693- 2	1.207- 2
6	7.599- 4	1.204- 2	6.735- 2	1.400- 1	5.388- 2	3.594- 2	1.230- 1	3.052- 2	1.242- 1	2.708- 1	1.201- 1
7	2.065- 4	3.899- 3	2.870- 2	9.503- 2	1.166- 1	1.055- 2	7.824- 2	7.047- 2	7.312- 2	6.340- 2	2.726- 1
8	5.700- 5	1.239- 3	1.110- 2	5.008- 2	1.091- 1	7.590- 2	4.778- 4	1.041- 1	2.602- 2	1.090- 1	2.176- 2
9	1.654- 5	3.945- 4	4.086- 3	2.294- 2	7.853- 2	1.024- 1	3.515- 2	1.658- 2	1.047- 1	2.777- 3	1.272- 1
10	4.881- 6	1.274- 4	1.474- 3	9.718- 3	3.815- 2	8.391- 2	8.085- 2	8.103- 3	4.367- 2	8.428- 2	2.434- 3
11	1.477- 6	4.192- 5	5.299- 4	3.947- 3	1.851- 2	5.370- 2	8.565- 2	5.170- 2	4.042- 5	6.743- 2	5.395- 2
12	4.594- 7	1.403- 5	1.918- 4	1.572- 3	8.437- 3	2.983- 2	6.579- 2	7.643- 2	2.432- 2	8.601- 3	7.867- 2
13	1.479- 7	4.771- 6	7.018- 5	6.225- 4	3.713- 3	1.522- 2	4.132- 2	7.115- 2	5.806- 2	6.010- 3	2.648- 2
14	4.944- 8	1.647- 6	2.593- 5	2.471- 4	1.602- 3	7.372- 3	2.393- 2	5.235- 2	6.822- 2	3.628- 2	4.695- 7
15	1.701- 8	5.781- 7	9.664- 6	9.851- 5	6.868- 4	3.465- 3	1.276- 2	3.352- 2	5.867- 2	5.766- 2	1.685- 2
16	5.876- 9	2.066- 7	3.627- 6	3.945- 5	2.939- 4	1.681- 3	6.517- 3	1.957- 2	4.234- 2	5.926- 2	4.214- 2
17	1.962- 9	7.493- 8	1.371- 6	1.584- 5	1.258- 4	7.330- 4	3.241- 3	1.091- 2	2.740- 2	4.803- 2	5.379- 2
18	6.364-10	2.723- 8	5.212- 7	6.362- 6	5.395- 5	3.341- 4	1.585- 3	5.837- 3	1.652- 2	3.484- 2	5.092- 2
19	1.660-10	9.700- 9	1.987- 7	2.555- 6	2.301- 5	1.519- 4	7.601- 4	3.048- 3	9.504- 3	2.287- 2	4.065- 2
20	3.879-11	3.279- 9	7.522- 8	1.024- 6	9.799- 6	6.879- 5	3.696- 4	1.557- 3	5.294- 3	1.415- 2	2.912- 2

Table 62 (cont'd)

(N2+ MEINEL)

VV	11	12	13	14	15	16	17	18	19	20
0	7.164-11	2.059-12	1.041-11	7.375-12	1.394-13	9.552-13	1.005-12	2.371-13	1.014-14	8.502-14
1	1.343-11	1.474-10	2.123-11	1.789-11	2.966-11	2.073-12	4.850-12	5.809-12	7.656-13	3.389-13
2	1.856-10	1.398-13	4.191-10	5.582-11	2.906-12	3.516-11	1.423-11	2.719-13	7.700-12	5.091-12
3	7.791-10	9.719-11	3.342-12	1.060-10	9.271-11	1.012-14	3.809-11	2.955-11	7.747-13	7.502-12
4	5.139- 6	1.995- 9	6.103-12	7.503-12	5.660-11	9.555-11	3.944-12	2.354-11	3.679-11	7.403-12
5	6.744- 4	1.897- 5	3.140- 9	3.406-11	9.855-12	4.248-11	9.356-11	1.358-11	1.515-11	4.765-11
6	1.958- 2	1.220- 3	2.092- 5	3.273- 9	2.834-10	2.339-12	2.179-11	7.134-11	1.625-11	8.763-12
7	1.550- 1	2.952- 2	2.037- 3	3.636- 5	1.833- 9	9.348-10	1.013-14	3.370-12	4.492-11	1.846-11
8	2.571- 1	1.993- 1	4.194- 2	3.194- 3	5.802- 5	3.403-11	1.559- 9	8.348-12	3.978-13	1.981-11
9	2.128- 3	2.293- 1	2.209- 1	5.676- 2	4.713- 3	9.994- 5	3.574- 9	2.273- 9	5.124-11	1.323-11
10	1.252- 1	2.247- 3	1.916- 1	2.478- 1	7.373- 2	5.563- 3	1.275- 6	2.503- 8	2.421- 9	1.316-10
11	1.881- 2	1.070- 1	1.680- 2	1.502- 1	2.690- 1	9.253- 2	9.035- 3	1.746- 4	8.617- 8	1.805- 9
12	2.525- 2	4.247- 2	7.977- 2	3.934- 2	1.102- 1	2.837- 1	1.127- 1	1.130- 2	2.294- 4	2.262- 7
13	7.512- 2	5.231- 3	6.453- 2	5.079- 2	5.383- 2	7.444- 2	2.919- 1	1.339- 1	1.518- 2	2.891- 4
14	4.512- 2	5.005- 2	6.697- 3	7.895- 2	2.598- 2	8.555- 2	4.505- 2	2.939- 1	1.557- 1	1.885- 2
15	5.243- 3	5.777- 2	3.960- 2	5.305- 3	9.317- 2	9.920- 3	1.015- 1	2.312- 2	2.304- 1	1.777- 1
16	4.120- 3	1.702- 2	6.167- 2	2.011- 2	1.814- 2	7.772- 2	8.315- 4	1.102- 1	8.820- 3	2.828- 1
17	2.546- 2	1.546- 6	3.183- 2	5.520- 2	6.275- 3	3.357- 2	6.514- 2	1.078- 3	1.115- 1	1.581- 3
18	4.340- 2	1.134- 2	3.829- 3	4.314- 2	4.207- 2	2.516- 4	4.725- 2	4.857- 2	7.862- 3	1.060- 1
19	4.355- 2	3.035- 2	2.497- 3	1.299- 2	4.856- 2	2.800- 2	1.955- 3	5.622- 2	3.223- 2	1.885- 2
20	4.362- 2	4.182- 2	1.739- 2	3.745- 5	2.336- 2	4.724- 2	1.434- 2	9.178- 3	5.916- 2	1.781- 2

Table 63

RKR FRANCK-CONDON FACTORS FOR(N2+ 1ST. NEG.)

V'\V"	0	1	2	3	4	5	6	7	8	9	10
0	6.632- 1	2.553- 1	6.354- 2	1.366- 2	2.921- 3	6.714- 4	1.632- 4	3.471- 5	4.323- 6	3.142- 8	2.190- 7
1	2.895- 1	2.385- 1	2.836- 1	1.290- 1	4.178- 2	1.138- 2	2.825- 3	6.692- 4	1.487- 4	2.639- 5	2.446- 6
2	4.451- 2	3.999- 1	5.749- 2	2.289- 1	1.648- 1	7.133- 2	2.391- 2	6.737- 3	1.760- 3	4.376- 4	1.017- 4
3	2.326- 3	9.934- 2	4.239- 1	2.972- 3	1.533- 1	1.798- 1	9.388- 2	3.780- 2	1.275- 2	3.812- 3	1.039- 3
4	2.017- 5	6.363- 3	1.607- 1	3.948- 1	4.415- 3	8.794- 2	1.557- 1	1.079- 1	5.111- 2	1.996- 2	6.915- 3
5	3.119- 6	6.831- 6	1.112- 2	2.107- 1	3.668- 1	1.626- 2	4.485- 2	1.308- 1	1.104- 1	6.104- 2	2.657- 2
6	6.274- 7	2.287- 5	1.883- 5	1.207- 2	2.532- 1	3.636- 1	2.127- 2	2.103- 2	1.063- 1	1.056- 1	6.646- 2
7	1.868- 7	1.652- 9	1.166- 4	5.407- 4	9.335- 3	2.711- 1	3.735- 1	1.657- 2	7.935- 3	8.825- 2	9.680- 2
8	8.661- 8	1.552- 7	7.991- 8	2.395- 4	2.394- 3	3.090- 3	2.644- 1	4.283- 1	5.663- 3	1.633- 3	7.612- 2
9	1.991- 7	2.410-10	1.669- 5	1.101- 5	2.100- 4	5.316- 3	4.236- 4	2.280- 1	4.959- 1	6.165- 5	3.216- 5
10	3.812- 8	4.435- 7	4.256-10	5.051- 6	8.128- 5	1.975- 3	1.079- 2	1.563- 2	1.380- 1	5.501- 1	1.354- 2
11	5.245-10	4.420- 7	9.089-10	1.995- 5	4.237- 7	2.401- 4	4.886- 4	9.857- 3	5.716- 2	4.190- 2	5.438- 1
12	7.842- 9	4.969- 8	1.530- 7	1.964- 8	5.240- 6	1.499- 3	2.747- 4	3.675- 3	2.409- 3	1.098- 1	7.799- 4
13	5.090- 9	3.280- 8	2.524- 7	4.872- 8	1.312- 6	4.346- 5	1.383- 4	2.035- 7	8.286- 3	3.039- 3	1.182- 1
14	2.000- 9	1.169- 7	5.908- 9	3.469- 9	2.949- 8	4.834- 5	4.144- 6	3.116- 4	1.131- 3	7.378- 3	3.603- 2
15	1.149- 9	8.782- 8	1.713- 9	2.101- 8	4.931- 8	7.436- 7	7.824- 6	1.233- 4	6.573- 5	5.427- 3	3.156- 4
16	1.135- 9	2.668- 8	1.499- 7	2.994- 8	7.129- 8	1.117-10	6.631- 6	4.132- 5	2.995- 4	4.838- 4	7.830- 3
17	1.011- 9	1.375- 9	1.951- 7	9.192-10	3.072- 8	5.838- 8	1.129- 6	6.092- 6	1.175- 4	1.020- 4	4.068- 3
18	4.775-11	1.566- 9	1.113- 7	2.988- 8	4.789- 9	5.383- 8	4.952- 9	8.712- 6	7.465- 5	2.953- 4	3.663- 4
19	2.340-11	4.343- 9	2.305- 9	1.032- 7	1.278-10	3.350- 9	2.224- 7	2.935- 6	3.533- 6	1.358- 4	7.805- 5
20	1.690-10	3.625- 9	1.924-10	1.225- 7	2.926-10	2.275- 9	1.765- 7	1.789- 7	8.966- 6	1.794- 5	2.661- 4

Table 63 (cont'd)

(V2+ 1ST. VEC.)

V	VV 11	12	13	14	15	16	17	18	19	20
0	1.679- 7	1.350- 8	2.357- 9	9.692- 9	7.349- 9	2.102- 8	7.195-11	8.153- 9	1.705- 8	1.407- 8
1	7.805- 9	4.235- 8	1.151-10	5.637- 9	1.251- 7	1.814- 7	3.546- 9	1.011- 9	9.566- 9	2.926- 8
2	1.923- 5	2.218- 6	8.494- 8	3.322- 9	3.517- 8	9.605- 8	9.117- 9	3.415- 8	1.191- 9	9.118- 9
3	2.700- 4	6.574- 5	1.343- 5	1.616- 6	5.935- 8	7.539-10	1.438- 9	3.833- 8	2.516- 8	1.782- 9
4	2.077- 3	5.843- 4	1.555- 4	3.834- 5	7.210- 6	5.959- 7	1.902- 9	3.153- 8	2.219- 9	3.825- 9
5	1.065- 2	3.448- 3	1.361- 3	2.941- 4	7.488- 5	1.582- 5	2.555- 5	4.446- 8	1.172- 7	1.155- 7
6	3.191- 2	1.319- 2	4.885- 3	1.647- 3	4.936- 4	1.294- 4	2.947- 5	5.571- 6	6.333- 7	1.765-11
7	6.789- 2	3.579- 2	1.563- 2	6.309- 3	2.253- 3	7.313- 4	2.112- 4	5.229- 5	1.134- 5	2.305- 6
8	8.444- 2	6.657- 2	3.097- 2	1.784- 2	7.488- 3	2.816- 3	9.747- 4	3.137- 4	9.284- 5	2.497- 5
9	7.375- 2	7.037- 2	6.426- 2	3.618- 2	1.859- 2	9.213- 3	3.315- 3	1.225- 3	4.313- 4	1.464- 4
10	4.170- 3	8.451- 2	5.364- 2	6.244- 2	3.343- 2	1.852- 2	8.498- 3	3.677- 3	1.463- 3	5.591- 4
11	5.695- 2	1.575- 2	1.131- 1	3.337- 2	5.315- 2	2.798- 2	1.339- 2	6.120- 3	3.830- 3	1.614- 3
12	4.258- 1	1.100- 1	4.396- 2	1.658- 1	1.359- 2	7.153- 2	2.043- 2	1.914- 2	7.345- 3	3.866- 3
13	7.703- 2	2.213- 1	1.367- 1	6.808- 2	2.393- 1	9.319- 4	8.590- 2	1.128- 2	1.926- 2	5.981- 3
14	5.638- 2	2.218- 1	4.779- 2	9.094- 2	5.507- 2	3.096- 1	4.350- 3	1.214- 1	3.069- 3	2.318- 2
15	8.364- 2	5.325- 4	2.834- 1	1.256- 3	2.675- 2	3.050- 2	3.236- 1	2.274- 2	1.696- 1	1.399- 4
16	1.113- 2	8.111- 2	5.355- 2	1.878- 1	4.421- 2	5.485- 5	4.357- 4	2.818- 1	4.132- 2	2.244- 1
17	1.890- 3	5.232- 2	2.105- 2	1.728- 1	4.657- 2	5.431- 2	1.559- 2	2.717- 2	1.688- 1	4.091- 2
18	7.284- 3	4.281- 3	7.425- 2	7.498- 3	2.011- 1	5.850- 4	2.850- 2	2.520- 2	1.095- 1	5.758- 2
19	3.668- 3	2.381- 3	3.616- 2	3.295- 2	9.325- 2	9.938- 2	3.279- 2	3.234- 4	5.467- 3	1.743- 1
20	4.968- 4	5.288- 3	3.665- 3	5.922- 2	9.013- 4	1.549- 1	6.773- 3	3.634- 2	1.143- 2	9.403- 3

Table 64 RKR FRANCK-CONDON FACTORS FOR(N2+ 2ND. NEG.)

V V	0	1	2	3	4	5	6	7	8	9	10
0	1.317- 2	7.594- 2	1.916- 1	2.756- 1	2.461- 1	1.398- 1	4.839- 2	9.165- 3	7.086- 4	2.851- 6	3.453- 6
1	4.864- 2	1.565- 1	1.568- 1	2.726- 2	3.181- 2	1.882- 1	2.311- 1	1.251- 1	3.142- 2	2.775- 3	4.888- 6
2	9.626- 2	1.530- 1	2.608- 2	3.861- 2	1.177- 1	1.833- 2	5.685- 2	2.249- 1	1.969- 1	5.443- 2	6.353- 3
3	1.354- 1	8.345- 2	7.956- 3	9.668- 2	1.269- 2	5.560- 2	8.233- 2	1.428- 3	1.635- 1	2.455- 1	1.037- 1
4	1.517- 1	1.921- 2	6.118- 2	4.219- 2	2.441- 2	6.895- 2	1.957- 3	9.034- 2	1.370- 2	9.465- 2	2.688- 1
5	1.444- 1	1.732- 4	8.160- 2	1.641- 4	6.893- 2	3.072- 3	5.255- 2	1.408- 2	5.388- 2	4.622- 2	4.257- 2
6	1.217- 1	1.862- 2	5.308- 2	2.307- 2	3.927- 2	2.337- 2	3.789- 2	2.128- 2	4.572- 2	1.669- 2	6.869- 2
7	9.342- 2	4.836- 2	1.579- 2	5.504- 2	2.488- 3	5.443- 2	3.789- 5	5.488- 2	2.747- 4	5.817- 2	5.394- 4
8	6.688- 2	6.894- 2	1.382- 4	5.474- 2	9.301- 3	3.368- 2	2.469- 2	1.889- 2	3.618- 2	9.861- 3	4.686- 2
9	4.548- 2	7.519- 2	7.384- 3	3.894- 2	3.524- 2	4.116- 3	4.488- 2	8.993- 4	3.929- 2	1.848- 2	2.868- 2
10	2.953- 2	6.934- 2	2.417- 2	8.444- 3	4.553- 2	3.407- 3	2.866- 2	2.336- 2	7.528- 3	3.888- 2	4.252- 6

V V	11	12	13	14	15	16	17	18	19	20
0	2.889- 7	3.233- 8	4.612- 9	7.976-10	7.862-11	5.837-11	2.881-13	2.899-12	1.213-13	5.618-14
1	2.136- 5	7.448- 7	3.167- 7	1.709- 8	9.787- 9	1.392-10	4.274-10	4.922-12	1.481-11	3.169-12
2	1.421- 6	7.215- 5	1.098- 6	1.505- 6	1.881- 8	5.297- 8	9.339-11	1.998- 9	1.919-10	3.282-11
3	1.117- 2	3.417- 6	1.756- 4	5.262- 7	4.699- 5	2.455-10	1.717- 7	6.998- 9	4.888- 9	1.609- 9
4	1.452- 1	1.378- 2	5.865- 5	3.435- 4	1.381- 7	1.387- 5	1.753- 7	3.718- 7	5.619- 8	5.488- 9
5	2.719- 1	1.854- 1	2.271- 2	2.123- 4	5.711- 4	5.956- 5	1.988- 5	1.328- 6	5.311- 7	2.368- 7
6	1.261- 2	2.614- 1	2.261- 1	2.862- 2	5.748- 4	8.348- 4	3.114- 5	2.934- 5	4.884- 6	4.869- 7
7	7.281- 2	9.459- 4	2.438- 1	2.637- 1	3.435- 2	1.213- 3	1.689- 3	9.696- 5	3.692- 5	1.176- 5
8	4.662- 3	6.242- 2	1.351- 3	2.283- 1	2.993- 1	3.997- 2	2.147- 3	1.258- 3	2.421- 4	4.384- 5
9	2.518- 2	1.985- 2	4.478- 2	8.254- 3	1.953- 1	3.335- 1	4.528- 2	3.133- 3	1.183- 3	5.692- 4
10	3.989- 2	7.851- 3	3.289- 2	2.612- 2	1.738- 2	1.573- 1	3.692- 1	5.698- 2	3.095- 3	6.189- 4

Table 65 RKR FRANCK-CONDON FACTORS FOR (NO GAMMA (1/2))

V''	0	1	2	3	4	5	6	7	8	9	10	11
0	1.605-1	2.611-1	2.397-1	1.614-1	9.156-2	4.893-2	2.234-2	9.604-3	3.932-3	1.538-3	5.947-4	2.320-4
1	3.322-1	1.075-1	6.730-4	7.315-2	1.302-1	1.317-1	9.308-2	5.197-2	3.396-2	1.702-2	8.120-3	3.784-3
2	2.927-1	1.423-2	1.544-1	7.324-2	5.478-4	3.303-2	8.552-2	1.047-1	8.998-2	6.329-2	3.949-2	2.283-2
3	1.541-1	1.931-1	4.795-2	3.778-2	1.115-1	5.141-2	7.533-4	2.133-2	6.287-2	8.340-2	7.901-2	6.211-2
4	5.043-2	2.413-1	4.005-2	1.235-1	2.496-3	5.400-2	8.732-2	3.443-2	2.436-4	1.721-2	4.987-2	6.987-2
5	1.100-2	1.344-1	2.161-1	8.325-4	1.039-1	4.750-2	4.139-3	6.275-2	5.703-2	2.135-2	1.841-7	1.577-2

V''	12	13	14	15	16	17	18	19	20	21	22	23
0	9.034-5	3.667-5	1.585-5	7.448-6	3.749-6	1.955-6	9.913-7	2.475-7	2.520-8	9.361-9	6.653-8	1.015-7
1	1.705-3	7.573-4	3.397-4	1.539-4	6.970-5	2.994-5	1.158-5	3.955-6	1.054-6	1.874-7	9.943-9	3.850-9
2	1.224-2	5.183-3	3.010-3	1.431-3	6.735-4	3.083-4	1.377-4	5.985-5	2.437-5	9.239-6	3.144-6	8.744-7
3	4.200-2	2.555-2	1.451-2	7.477-3	4.161-3	2.111-3	1.032-3	4.939-4	2.273-4	1.023-4	4.484-5	1.921-5
4	6.969-2	5.052-2	4.016-2	2.008-2	1.597-2	9.234-3	5.176-3	2.715-3	1.371-3	6.767-4	3.296-4	1.542-4
5	4.280-2	5.894-2	6.000-2	5.038-2	3.859-2	2.041-2	1.556-2	1.012-2	5.639-3	3.155-3	1.722-3	9.383-4

Table 66

RKR FRANCK-CONDON FACTORS FOR (NO GAMMA (3/2))

V	VV 0	1	2	3	4	5	6	7	8	9	10	11
0	1.511- 1	2.516- 1	2.346- 1	1.674- 1	9.994- 2	5.205- 2	2.457- 2	1.074- 2	4.406- 3	1.746- 3	6.965- 4	2.618- 4
1	3.261- 1	1.166- 1	7.001- 8	5.858- 2	1.243- 1	1.316- 1	1.021- 1	5.598- 2	3.744- 2	1.935- 2	9.396- 3	4.350- 3
2	2.975- 1	9.639- 3	1.434- 1	8.214- 2	2.465- 3	2.526- 2	7.835- 2	1.024- 1	9.275- 2	6.782- 2	4.334- 2	2.517- 2
3	1.566- 1	1.849- 1	3.738- 2	2.788- 2	1.076- 1	5.826- 2	2.779- 3	1.520- 2	5.622- 2	8.089- 2	8.031- 2	6.453- 2
4	5.378- 2	2.449- 1	3.375- 2	1.257- 1	5.981- 3	4.419- 2	9.678- 2	6.131- 2	1.623- 3	1.198- 2	4.408- 2	6.647- 2
5	1.248- 2	1.402- 1	2.136- 1	3.834- 3	9.301- 2	5.488- 2	1.337- 3	5.474- 2	6.878- 2	2.785- 2	5.104- 4	1.116- 2

V	VV 12	13	14	15	16	17	18	19	20	21	22	23
0	1.196- 4	5.251- 5	2.306- 5	9.528- 6	3.538- 6	1.125- 6	2.792- 7	4.798- 8	3.761- 9	3.573-11	7.664-13	1.184- 9
1	1.968- 3	8.810- 4	3.969- 4	1.788- 4	8.011- 5	3.499- 5	1.399- 5	4.826- 6	1.309- 6	2.825- 7	2.743- 9	1.837- 9
2	1.361- 2	6.996- 3	3.467- 3	1.668- 3	7.797- 4	3.541- 4	1.658- 4	7.158- 5	2.897- 5	1.012- 5	2.838- 6	5.349- 7
3	4.490- 2	2.821- 2	1.646- 2	8.995- 3	4.698- 3	2.392- 3	1.174- 3	5.611- 4	2.520- 4	1.168- 4	4.928- 5	1.935- 5
4	6.981- 2	5.928- 2	4.368- 2	2.878- 2	1.754- 2	1.020- 2	5.646- 3	3.011- 3	1.569- 3	7.824- 4	3.701- 4	1.758- 4
5	3.753- 2	5.603- 2	6.096- 2	5.333- 2	4.053- 2	2.833- 2	1.824- 2	1.138- 2	6.490- 3	3.623- 3	1.945- 3	1.016- 3

Table 67

RKR FRANCK-CONDON FACTORS FOR (NO BETA (1/2))

V' \ VV	0	1	2	3	4	5	6	7	8	9	10	11
0	1.769-5	2.473-4	1.671-3	7.411-3	2.312-2	5.344-2	9.772-2	1.438-1	1.714-1	1.703-1	1.438-1	9.467-2
1	1.451-4	1.682-3	9.120-3	3.107-2	7.019-2	1.073-1	1.120-1	7.112-2	1.635-2	2.350-3	4.666-2	1.088-1
2	6.172-4	5.892-3	2.521-2	6.380-2	9.718-2	8.248-2	2.916-2	2.245-4	3.649-2	8.094-2	6.325-2	1.106-2
3	1.840-3	1.433-2	4.740-2	8.480-2	7.607-2	2.081-2	2.801-3	4.697-2	6.353-2	1.963-2	4.234-3	5.354-2
4	4.330-3	2.721-2	6.760-2	7.941-2	2.930-2	8.457-4	4.127-2	5.349-2	9.101-3	1.417-2	5.783-2	3.314-2
5	8.523-3	4.253-2	7.041-2	4.395-2	1.518-3	2.652-2	5.158-2	3.923-3	1.275-2	5.070-2	1.843-2	5.831-3
6	1.402-2	5.714-2	6.991-2	1.802-2	7.451-3	4.778-2	2.044-2	4.703-3	4.352-2	1.881-2	5.938-3	4.583-2
7	2.295-2	6.753-2	5.117-2	1.047-3	3.006-2	3.727-2	9.022-5	3.215-2	2.740-2	1.278-3	3.897-2	1.771-2
8	3.161-2	7.062-2	2.805-2	4.304-3	4.311-2	1.195-2	1.242-2	3.659-2	1.253-3	2.073-2	2.451-2	2.334-3
9	4.093-2	6.582-2	9.466-3	1.984-2	3.636-2	1.328-5	3.171-2	1.447-2	9.298-3	3.275-2	3.356-4	2.898-2
10	4.955-2	5.506-2	6.024-4	3.320-2	1.850-2	8.395-3	3.237-2	1.159-4	2.893-2	1.353-2	1.311-2	2.091-2
11	5.672-2	4.065-2	1.843-3	3.835-2	3.656-3	2.391-2	1.536-2	4.299-3	2.749-2	2.563-4	2.928-2	3.494-3
12	6.247-2	2.613-2	1.013-2	3.323-2	3.294-4	3.139-2	2.194-3	2.359-2	1.802-2	1.340-2	1.928-2	4.472-3
13	6.617-2	1.363-2	2.089-2	2.158-2	7.403-3	2.586-2	1.490-3	2.715-2	3.963-5	2.575-2	2.303-3	2.152-2
14	6.794-2	4.917-3	2.977-2	9.543-3	1.820-2	1.334-2	1.136-2	1.705-2	6.432-3	2.061-2	2.808-3	2.305-2
15	6.821-2	5.654-4	3.444-2	1.752-3	2.574-2	2.929-3	2.142-2	4.572-3	1.848-2	6.655-3	1.564-2	8.819-3
16	6.659-2	4.305-4	3.389-2	1.972-4	2.637-2	1.238-4	2.356-2	2.878-5	2.258-2	2.272-7	2.192-2	3.022-5
17	6.366-2	3.862-3	2.902-2	4.238-3	2.076-2	4.845-3	1.758-2	5.048-3	1.616-2	5.455-3	1.505-2	5.948-3
18	5.927-2	9.821-3	2.133-2	1.147-2	1.204-2	1.290-2	9.851-3	1.370-2	5.793-3	1.502-2	4.021-3	1.625-2
19	5.369-2	1.719-2	1.302-2	1.889-2	4.268-3	1.924-2	1.259-3	1.881-2	1.671-4	1.981-2	6.371-5	1.817-2

Table 67 (cont'd)

(NO BETA (1/2))

VV	12	13	14	15	16	17	18	19	20	21	22	23
J	5.375-2	2.597-2	1.050-2	3.489-3	8.933-4	1.707-4	2.834-5	5.877-5	8.197-7	1.120-8	1.770-8	2.469-8
1	1.403-1	1.270-1	8.577-2	4.448-2	1.771-2	5.530-3	1.415-3	2.691-4	4.143-5	3.967-6	1.122-9	8.264-9
2	7.802-3	6.663-2	1.261-1	1.337-1	9.468-2	4.899-2	1.919-2	5.549-3	1.187-3	1.753-4	1.502-5	5.337-7
3	7.215-2	2.530-2	1.635-3	5.534-2	1.220-1	1.326-1	9.238-2	4.381-2	1.458-2	3.577-3	5.559-4	4.829-5
4	1.166-4	4.140-2	7.100-2	2.534-2	2.699-3	6.403-2	1.314-1	1.278-1	7.777-2	3.152-2	8.195-3	1.311-3
5	5.082-2	3.453-2	1.550-4	4.489-2	6.668-2	1.485-2	1.134-2	9.822-2	1.434-1	1.148-1	5.371-2	1.580-2
6	1.891-2	6.827-3	5.062-2	2.629-2	3.135-3	5.665-2	5.439-2	2.079-3	3.997-2	1.305-1	1.414-1	8.163-2
7	6.830-3	4.434-2	1.175-2	1.381-2	5.187-2	1.155-2	1.655-2	6.795-2	2.858-2	6.194-3	9.555-2	1.565-1
8	3.827-2	1.083-2	1.430-2	4.138-2	2.177-3	2.973-2	4.306-2	1.866-4	4.497-2	5.887-2	1.492-3	5.592-2
9	1.703-2	7.287-3	3.666-2	1.929-3	2.797-2	2.893-2	1.928-3	4.679-2	1.874-2	1.306-2	6.784-2	1.929-2
10	6.035-4	3.265-2	6.197-3	1.957-2	2.716-2	1.747-3	4.030-2	8.382-3	2.199-2	4.328-2	2.784-8	9.337-2
11	2.114-2	1.666-2	7.476-3	2.997-2	1.480-5	3.261-2	8.712-3	1.893-2	3.192-2	1.561-3	4.737-2	1.058-2
12	2.706-2	1.959-5	2.845-2	3.587-3	2.233-2	1.531-2	1.021-2	3.049-2	5.806-4	3.848-2	5.022-3	3.047-2
13	8.081-3	1.471-2	1.622-2	7.356-3	2.441-2	1.489-3	3.087-2	4.525-4	2.996-2	7.352-3	2.293-2	2.311-2
14	4.884-4	2.480-2	1.535-4	2.470-2	2.195-3	2.244-2	7.192-3	1.795-2	1.535-2	1.121-2	2.520-2	4.467-3
15	1.274-2	1.214-2	9.599-3	1.558-2	6.744-3	1.979-2	3.717-3	2.414-2	1.229-3	2.777-2	6.231-5	3.119-2
16	2.168-2	2.403-4	2.157-2	6.340-4	2.168-2	1.498-3	2.150-2	2.775-3	2.139-2	4.556-3	2.135-2	7.102-3
17	1.470-2	5.955-3	1.483-2	5.981-3	1.514-2	5.369-3	1.531-2	5.891-3	1.753-2	5.889-3	1.880-2	6.071-3
18	2.870-3	1.709-2	2.056-3	1.709-2	1.371-3	1.890-2	9.893-4	2.023-2	6.749-4	2.157-2	2.709-4	2.332-2
19	6.841-4	1.721-2	1.820-3	1.596-2	3.436-3	1.454-2	5.144-3	1.324-2	7.439-3	1.144-2	1.068-2	9.306-3

Table 68

R&R FRANCK-CONDON FACTORS FOR (NO BETA (3/2))

VV	0	1	2	3	4	5	6	7	8	9	10	11
0	1.910- 5	2.694- 4	1.853- 3	7.950- 3	2.420- 2	5.623- 2	1.008- 1	1.441- 1	1.713- 1	1.705- 1	1.389- 1	9.241- 2
1	1.559- 4	1.816- 3	9.993- 3	3.274- 2	7.193- 2	1.039- 1	1.115- 1	5.598- 2	1.393- 2	3.273- 3	4.947- 2	1.126- 1
2	8.594- 4	5.305- 3	2.727- 2	8.608- 2	9.699- 2	8.102- 2	2.547- 2	5.992- 4	3.973- 2	8.170- 2	5.999- 2	9.939- 3
3	1.956- 3	1.519- 2	5.153- 2	8.537- 2	7.292- 2	1.828- 2	4.079- 3	4.934- 2	6.248- 2	1.620- 2	5.708- 3	5.655- 2
4	4.582- 3	2.856- 2	7.968- 2	7.762- 2	2.630- 2	1.641- 3	4.399- 2	5.156- 2	6.295- 3	1.650- 2	5.833- 2	3.023- 2
5	8.976- 3	4.427- 2	7.857- 2	4.633- 2	6.778- 4	2.965- 2	5.062- 2	7.723- 3	1.510- 2	5.867- 2	1.566- 2	7.746- 3
6	1.533- 2	5.877- 2	7.034- 2	1.530- 2	9.554- 3	4.855- 2	1.768- 2	5.385- 3	4.452- 2	1.623- 2	7.711- 3	4.651- 2
7	2.355- 2	6.858- 2	4.962- 2	3.895- 4	3.268- 2	3.512- 2	2.045- 5	3.452- 2	2.486- 2	2.290- 3	3.976- 2	1.520- 2
8	3.288- 2	7.093- 2	2.575- 2	5.740- 3	4.365- 2	9.682- 3	1.521- 2	3.573- 2	5.134- 4	2.877- 2	2.211- 2	3.030- 3
9	4.230- 2	6.523- 2	7.637- 3	2.171- 2	3.466- 2	7.731- 5	3.362- 2	1.216- 2	1.152- 2	3.150- 2	3.479- 5	3.035- 2
10	5.116- 2	5.371- 2	1.943- 4	3.546- 2	1.610- 2	1.139- 2	3.133- 2	5.233- 6	3.033- 2	8.376- 3	1.534- 2	2.507- 2
11	5.834- 2	3.887- 2	2.948- 3	3.881- 2	2.376- 3	2.556- 2	1.393- 2	1.056- 2	2.607- 2	8.428- 4	2.971- 2	2.218- 3
12	6.401- 2	2.428- 2	1.222- 2	3.182- 2	9.189- 4	3.130- 2	1.095- 3	2.558- 2	7.994- 3	1.560- 2	1.732- 2	6.138- 3
13	6.752- 2	1.208- 2	2.336- 2	1.919- 2	9.402- 3	2.487- 2	2.710- 3	2.631- 2	4.635- 5	2.629- 2	1.204- 3	2.303- 2
14	6.903- 2	3.917- 3	3.138- 2	7.301- 3	2.026- 2	1.121- 2	1.364- 2	1.513- 2	8.352- 3	1.989- 2	4.204- 3	2.234- 2
15	6.896- 2	2.497- 4	3.489- 2	7.986- 4	2.691- 2	1.881- 3	2.284- 2	3.856- 3	2.817- 2	4.312- 3	1.746- 2	7.029- 3
16	6.697- 2	8.347- 4	3.317- 2	7.988- 4	2.599- 2	5.217- 4	2.327- 2	3.635- 4	2.254- 2	1.591- 4	2.194- 2	5.019- 3
17	6.365- 2	4.927- 3	2.738- 2	6.891- 3	1.922- 2	6.334- 3	1.584- 2	5.982- 3	1.451- 2	7.178- 3	1.346- 2	7.072- 3
18	5.889- 2	1.142- 2	1.924- 2	1.385- 2	1.815- 2	1.458- 2	5.262- 3	1.558- 2	4.247- 3	1.646- 2	2.735- 3	1.752- 2
19	5.319- 2	1.985- 2	1.339- 2	2.694- 2	2.902- 3	2.887- 2	5.259- 4	1.946- 2	9.938- 5	1.867- 2	4.116- 4	1.765- 2

Table 68 (cont'd)

(NO BETA (3/2))

VV	12	13	14	15	16	17	18	19	20	21	22	23
0	5.192- 2	2.453- 2	9.732- 3	3.173- 3	8.217- 4	1.621- 4	2.795- 5	4.223- 6	2.577- 7	5.385- 9	2.0>8- 8	1.234-10
1	1.425- 1	1.251- 1	8.173- 2	4.187- 2	1.696- 2	5.246- 3	1.245- 3	2.339- 4	3.610- 5	3.894- 6	7.2>2- 8	1.534- 8
2	1.001- 2	7.156- 2	1.280- 1	1.317- 1	9.261- 2	4.651- 2	1.778- 2	5.113- 3	1.870- 3	1.644- 4	1.378- 5	1.956- 7
3	7.091- 2	2.190- 2	2.873- 3	5.995- 2	1.259- 1	1.306- 1	8.818- 2	4.138- 2	1.390- 2	3.197- 3	5.0>8- 4	5.129- 5
4	5.933- 4	4.535- 2	6.957- 2	2.136- 2	4.328- 3	6.339- 2	1.325- 1	1.258- 1	7.40>- 2	2.896- 2	7.749- 3	1.352- 3
5	5.258- 2	3.123- 2	7.016- 4	4.818- 2	6.553- 2	1.192- 2	1.491- 2	9.613- 2	1.415- 1	1.893- 1	5.2>2- 2	1.552- 2
6	1.600- 2	8.458- 3	5.163- 2	2.302- 2	4.931- 3	5.357- 2	3.153- 2	9.536- 4	4.425- 2	1.306- 1	1.394- 1	7.936- 2
7	9.032- 3	4.473- 2	9.229- 3	1.665- 2	5.176- 2	8.874- 3	2.826- 2	5.917- 2	2.439- 2	8.961- 3	9.742- 2	1.531- 1
8	3.871- 2	8.274- 3	1.697- 2	4.004- 2	1.850- 3	3.324- 2	4.039- 2	5.557- 6	4.880- 2	5.649- 2	9.6>9- 4	5.>75- 2
9	1.432- 2	9.728- 3	3.534- 2	9.429- 4	3.874- 2	2.626- 2	3.428- 3	4.836- 2	1.536- 2	1.575- 2	6.831- 2	1.785- 2
10	1.456- 3	3.320- 2	4.311- 3	2.198- 2	2.470- 2	3.234- 3	4.857- 2	5.918- 3	2.555- 2	4.155- 2	9.5>9- 5	5.496- 2
11	2.314- 2	1.335- 2	9.708- 3	2.856- 2	3.292- 4	3.414- 2	5.509- 3	2.282- 2	2.943- 2	2.722- 3	4.830- 2	9.327- 3
12	2.576- 2	3.757- 4	2.918- 2	2.255- 3	2.437- 2	1.278- 2	1.272- 2	2.832- 2	1.633- 3	3.924- 2	3.714- 3	3.258- 2
13	6.887- 3	1.699- 2	1.397- 2	9.309- 3	2.248- 2	2.744- 3	2.378- 2	3.515- 5	3.166- 2	5.573- 3	2.516- 2	2.173- 2
14	1.249- 3	2.434- 2	4.616- 6	2.526- 2	1.116- 3	2.431- 2	5.326- 3	2.012- 2	1.277- 2	1.358- 2	2.355- 2	5.818- 3
15	1.473- 2	9.865- 3	1.177- 2	1.378- 2	8.614- 3	1.798- 2	5.412- 3	2.243- 2	2.585- 3	2.734- 2	3.622- 4	3.187- 2
16	2.188- 2	2.151- 3	2.193- 2	1.713- 4	2.211- 2	5.937- 4	2.271- 2	1.513- 3	2.301- 2	3.139- 3	2.278- 2	5.813- 3
17	1.294- 2	7.783- 3	1.289- 2	7.705- 3	1.326- 2	7.876- 3	1.432- 2	7.747- 3	1.551- 2	7.626- 3	1.727- 2	7.607- 3
18	1.781- 3	1.812- 2	1.023- 3	1.888- 2	6.843- 4	1.959- 2	3.394- 4	2.054- 2	1.338- 4	2.212- 2	3.5>4- 5	2.378- 2
19	1.517- 3	1.613- 2	3.051- 3	1.403- 2	4.888- 3	1.292- 2	5.901- 3	1.134- 2	9.411- 3	9.858- 3	1.215- 2	7.968- 3

Table 69 RKR FRANCK-CONDON FACTORS FOR (NO DE_TA (1/2))

V	VV 0	1	2	3	4	5	6	7	8	9	10	11
0	1.619-1	2.013-1	2.405-1	1.820-1	9.149-2	4.629-2	2.124-2	8.855-3	3.412-3	1.219-3	4.150-4	1.357-4
1	3.488-1	1.832-1	1.499-3	7.544-2	1.334-1	1.303-1	8.547-2	5.729-2	2.978-2	1.384-2	5.964-3	2.427-3
2	3.041-1	2.579-2	1.618-1	6.049-2	1.535-4	4.493-2	9.700-2	1.055-1	8.457-2	5.468-2	3.097-2	1.595-2
3	1.410-1	2.403-1	2.553-2	6.282-2	1.096-1	3.141-2	1.327-3	3.939-2	9.037-2	8.447-2	7.242-2	5.001-2
4	3.757-2	2.483-1	9.756-2	9.932-2	2.755-3	8.148-2	7.179-2	1.093-2	5.934-3	4.279-2	7.227-2	7.734-2

V	VV 12	13	14	15	16	17	18	19	20	21	22	23
0	4.132-5	1.192-5	3.367-6	9.748-7	2.944-7	7.711-8	5.448-9	9.033-3	6.253-8	1.322-7	1.759-7	1.526-7
1	9.113-4	3.203-4	1.067-4	3.208-5	8.392-5	1.273-5	2.318-9	3.158-7	7.051-7	7.485-7	6.444-7	4.123-7
2	7.304-3	3.081-3	1.175-3	4.351-4	1.223-4	2.692-5	3.973-6	7.935-9	8.084-7	1.729-6	1.967-6	1.659-6
3	2.921-2	1.501-2	6.955-3	2.928-3	1.115-3	3.641-4	9.485-5	1.620-5	5.124-7	1.025-6	3.343-6	4.432-6
4	6.270-2	4.195-2	2.429-2	1.250-2	5.834-3	2.455-3	9.884-4	2.659-4	5.448-5	3.857-6	1.171-6	6.561-6

Table 70 RKR FRANCK-CONDON FACTORS FOR (NO DELTA (3/2))

V V	0	1	2	3	4	5	6	7	8	9	10	11
0	1.524-1	2.524-1	2.354-1	1.684-1	9.995-2	5.145-2	2.374-2	9.985-3	3.861-3	1.434-3	4.947-4	1.723-4
1	3.427-1	1.123-1	1.634-4	6.357-2	1.279-1	1.314-1	9.858-2	6.151-2	3.315-2	1.598-2	7.056-3	2.979-3
2	3.098-1	1.934-2	1.544-1	6.998-2	2.113-4	3.611-2	8.934-2	1.055-1	8.828-2	5.951-2	3.466-2	1.798-2
3	1.478-1	2.335-1	3.359-2	4.984-2	1.093-1	3.848-2	9.850-5	3.202-2	7.443-2	8.814-2	7.582-2	5.323-2
4	4.024-2	2.545-1	8.399-2	1.085-1	5.568-4	7.263-2	7.556-2	1.633-2	2.699-3	3.549-2	6.785-2	7.664-2

V V	12	13	14	15	16	17	18	19	20	21	22	23
0	6.021-3	2.073-5	6.566-6	1.599-6	1.839-7	5.692-9	1.109-7	1.690-7	1.452-7	8.807-8	4.115-8	1.573-8
1	1.095-3	3.922-4	1.325-4	4.093-5	1.081-5	1.912-6	3.950-8	2.473-7	7.347-7	9.389-7	8.240-7	5.596-7
2	8.437-3	3.617-3	1.420-3	5.020-4	1.576-4	4.150-5	7.223-6	2.119-7	6.628-7	2.153-6	2.843-6	2.623-6
3	3.213-2	1.716-2	8.242-3	3.536-3	1.355-3	4.559-4	1.237-4	2.259-5	1.052-5	1.064-6	4.030-6	5.476-6
4	6.511-2	4.561-2	2.757-2	1.453-2	6.878-3	2.903-3	1.058-3	3.253-4	7.211-5	6.461-6	6.609-7	6.374-6

Table 71

RKR FRANCK-CONDON FACTORS FOR (NO EPSILON (1/2))

V'V"	0	1	2	3	4	5	6	7	8	9	10	11
0	1.620- 1	2.572- 1	2.342- 1	1.538- 1	9.248- 2	4.944- 2	2.463- 2	1.155- 2	5.132- 3	2.177- 3	8.994- 4	3.643- 4
1	3.385- 1	1.071- 1	4.760- 4	6.499- 2	1.228- 1	1.272- 1	9.898- 2	5.430- 2	3.703- 2	1.956- 2	9.841- 3	4.130- 3
2	2.943- 1	1.845- 2	1.035- 1	7.309- 2	8.387- 4	2.892- 2	7.909- 2	9.822- 2	8.646- 2	6.309- 2	4.073- 2	2.438- 2
3	1.453- 1	2.113- 1	4.231- 2	4.651- 2	1.142- 1	4.944- 2	7.178- 4	1.935- 2	5.902- 2	7.881- 2	7.542- 2	6.112- 2
4	4.398- 2	2.389- 1	5.193- 2	1.303- 1	4.956- 4	6.418- 2	8.728- 2	3.034- 2	5.735- 5	1.321- 2	4.995- 2	6.854- 2
5	9.195- 3	1.156- 1	2.111- 1	6.092- 4	1.255- 1	4.515- 2	9.534- 3	7.250- 2	6.523- 2	1.746- 2	2.540- 4	1.941- 2
6	1.584- 3	3.618- 2	1.730- 1	1.099- 1	5.436- 2	5.259- 2	3.525- 2	5.321- 3	3.094- 2	7.092- 2	4.814- 2	4.445- 3
7	2.909- 4	9.934- 3	9.034- 2	1.931- 1	1.975- 2	1.173- 1	1.939- 3	9.790- 2	4.564- 2	1.677- 3	4.726- 2	6.250- 2

V'V"	12	13	14	15	16	17	18	19	20	21	22	23
0	1.408- 4	5.336- 5	2.055- 5	8.376- 6	3.644- 6	1.567- 6	5.756- 7	1.291- 7	9.738-10	4.359- 8	1.202- 7	1.036- 7
1	2.225- 3	9.877- 4	4.244- 4	1.703- 4	7.019- 5	2.938- 5	8.803- 6	1.944- 6	2.334- 7	3.353- 9	1.336- 7	2.735- 7
2	1.339- 2	6.459- 3	3.334- 3	1.546- 3	6.858- 4	2.827- 4	1.062- 4	3.502- 5	9.294- 6	1.436- 6	9.417-10	4.842- 7
3	4.131- 2	2.544- 2	1.458- 2	7.774- 3	3.958- 3	1.898- 3	8.298- 4	3.331- 4	1.142- 4	3.864- 5	4.351- 6	3.970- 9
4	6.758- 2	5.431- 2	3.833- 2	2.455- 2	1.464- 2	8.844- 3	4.865- 3	1.838- 3	7.815- 4	2.758- 4	7.242- 5	8.653- 6
5	4.716- 2	5.161- 2	6.017- 2	4.923- 2	3.581- 2	2.329- 2	1.365- 2	7.341- 3	3.536- 3	1.529- 3	5.691- 4	1.559- 4
6	1.865- 3	2.268- 2	4.658- 2	5.747- 2	5.635- 2	4.552- 2	3.223- 2	2.059- 2	1.170- 2	5.998- 3	2.757- 3	1.065- 3
7	2.998- 2	2.403- 3	5.119- 3	2.682- 2	4.794- 2	5.638- 2	5.188- 2	4.076- 2	2.731- 2	1.721- 2	9.648- 3	4.715- 3

Table 72 RKR FRANCK-CONDON FACTORS FOR (NO EPSILON (3/2))

V V	0	1	2	3	4	5	6	7	8	9	10	11
0	1.526-1	2.480-1	2.292-1	1.646-1	1.036-1	5.446-2	2.718-2	1.275-2	5.690-3	2.452-3	1.040-3	4.368-4
1	3.323-1	1.160-1	1.114-5	5.396-2	1.169-1	1.257-1	1.014-1	6.814-2	4.049-2	2.292-2	1.126-2	5.479-3
2	3.035-1	1.303-2	1.515-1	8.258-2	2.999-3	2.181-2	7.121-2	9.559-2	8.914-2	6.725-2	4.443-2	2.665-2
3	1.524-1	2.034-1	5.155-2	3.463-2	1.110-1	5.638-2	2.655-3	1.419-2	5.275-2	7.636-2	7.652-2	6.228-2
4	4.695-2	2.433-1	4.127-2	1.355-1	2.621-3	5.390-2	9.728-2	3.766-2	1.029-3	1.294-2	4.432-2	6.540-2
5	9.913-3	1.241-1	2.065-1	3.540-3	1.172-1	5.369-2	4.730-3	6.494-2	6.820-2	2.307-2	5.673-5	1.431-2
6	1.670-3	3.869-2	1.866-1	9.517-2	6.602-2	4.115-2	1.024-1	1.020-2	2.254-2	6.685-2	5.064-2	1.259-2
7	2.938-4	9.695-3	8.799-2	1.893-1	1.224-2	1.211-1	9.813-3	9.055-2	5.458-2	1.117-4	3.946-2	6.185-2

V V	12	13	14	15	16	17	18	19	20	21	22	23
0	1.822-4	7.502-5	2.986-5	1.097-5	3.549-6	9.303-7	1.353-7	6.173-3	5.431-9	1.661-8	1.855-8	1.682-8
1	2.555-3	1.151-3	5.018-4	2.092-4	8.314-5	3.097-5	1.036-5	2.528-6	3.233-7	5.199-9	1.899-7	3.748-7
2	1.481-2	7.745-3	3.847-3	1.986-3	8.056-4	3.421-4	1.327-4	4.513-5	1.235-5	1.653-6	1.117-8	8.756-7
3	4.404-2	2.803-2	1.643-2	8.899-3	4.517-3	2.174-3	9.577-4	3.924-4	1.337-4	3.913-5	5.530-6	1.946-8
4	6.775-2	5.704-2	4.175-2	2.720-2	1.618-2	8.988-3	4.631-3	2.169-3	9.321-4	3.393-4	9.440-5	1.351-5
5	4.130-2	5.971-2	6.160-2	5.187-2	3.801-2	2.525-2	1.518-2	8.367-3	4.171-3	1.846-3	6.928-4	1.974-4
6	4.108-4	1.752-2	4.238-2	5.667-2	5.647-2	4.741-2	3.471-2	2.270-2	1.348-2	7.384-3	3.258-3	1.262-3
7	3.501-2	5.133-3	2.505-3	2.199-2	4.391-2	5.518-2	5.337-2	4.322-2	3.098-2	1.959-2	1.097-2	5.391-3

Table 73 RKR FRANCK-CONDON FACTORS FOR (N) BETA PRIME (1/2)

VV	0	1	2	3	4	5	6	7	8	9	10	11
0	2.021- 2	8.723- 2	1.747- 1	2.362- 1	2.164- 1	1.433- 1	7.379- 2	3.032- 2	9.897- 3	2.593- 3	5.496- 4	9.753- 5
1	6.573- 2	1.696- 1	1.373- 1	2.977- 2	9.902- 3	1.019- 1	1.742- 1	1.593- 1	9.599- 2	4.356- 2	1.504- 2	3.424- 3
2	1.165- 1	1.375- 1	1.895- 2	3.120- 2	1.104- 1	5.559- 2	1.129- 4	5.511- 2	1.508- 1	1.536- 1	9.824- 2	4.313- 2
3	1.505- 1	6.146- 2	1.174- 2	9.188- 2	2.892- 2	1.648- 2	9.275- 2	5.393- 2	9.678- 5	6.428- 2	1.405- 1	1.419- 1
4	1.592- 1	7.729- 3	5.431- 2	4.595- 2	9.315- 3	7.716- 2	1.939- 2	2.124- 2	8.714- 2	3.845- 2	2.941- 3	7.849- 2
5	1.453- 1	4.400- 3	7.989- 2	8.093- 4	6.816- 2	2.447- 2	1.989- 2	5.821- 2	5.996- 3	3.760- 2	8.177- 2	1.833- 2

VV	12	13	14	15	16	17	18	19	20	21	22	23
0	1.496- 5	1.217- 6	3.377- 8	9.940- 9	5.363- 8	3.892- 8	1.673- 9	3.733- 8	8.714-10	2.411- 8	3.372- 9	6.397- 9
1	7.978- 4	1.340- 4	2.887- 5	3.463- 6	3.268- 7	2.416- 8	2.764- 8	4.516- 8	1.850- 8	4.250- 8	3.881-10	3.249- 8
2	1.419- 2	3.698- 3	7.925- 4	1.370- 4	1.532- 5	6.858- 7	2.588- 8	5.236- 8	2.194- 8	3.991- 9	5.735- 9	1.949- 9
3	8.526- 2	3.734- 2	1.194- 2	2.913- 3	5.278- 4	6.750- 5	5.593- 6	5.953- 7	1.864- 7	3.750- 8	2.739- 8	6.437- 9
4	1.459- 1	1.297- 1	7.248- 2	2.949- 2	8.858- 3	1.718- 3	2.692- 4	3.415- 5	5.211- 6	5.533- 7	6.933-10	8.957- 9
5	1.448- 1	1.814- 1	1.468- 1	1.116- 1	5.395- 2	1.844- 2	4.732- 3	8.944- 4	1.363- 4	1.933- 5	1.709- 6	8.187- 8

Table 74 RKR FRANCK-CONDON FACTORS FOR (NO BETA PRIME (3/2))

V'V	0	1	2	3	4	5	6	7	8	9	10	11
0	2.122- 2	9.080- 2	1.871- 1	2.371- 1	2.106- 1	1.439- 1	7.141- 2	2.798- 2	8.972- 3	2.478- 3	5.082- 4	9.930- 5
1	6.841- 2	1.633- 1	1.363- 1	2.518- 2	1.323- 2	1.095- 1	1.757- 1	1.546- 1	9.345- 2	4.202- 2	1.420- 2	3.643- 3
2	1.202- 1	1.355- 1	1.499- 2	3.655- 2	1.112- 1	5.288- 2	7.052- 4	7.081- 2	1.522- 1	1.520- 1	9.478- 2	4.137- 2
3	1.539- 1	5.740- 2	1.515- 2	9.326- 2	2.420- 2	2.043- 2	9.522- 2	4.837- 2	5.857- 4	6.926- 2	1.479- 1	1.407- 1
4	1.612- 1	5.807- 3	6.937- 2	4.104- 2	1.258- 2	7.755- 2	1.545- 2	2.582- 2	8.756- 2	3.408- 2	4.620- 3	8.471- 2
5	1.455- 1	6.196- 3	7.997- 2	9.027- 5	6.272- 2	2.828- 2	2.463- 2	5.718- 2	3.820- 3	4.195- 2	7.975- 2	1.493- 2

V'V	12	13	14	15	16	17	18	19	20	21	22	23
0	7.161- 6	9.357- 7	6.278- 7	7.251- 8	6.249- 8	4.148- 9	1.883- 8	3.237-10	7.352- 9	1.742-11	2.869- 9	1.223- 9
1	7.110- 4	1.899- 4	1.907- 5	3.910- 6	5.613- 8	7.701- 8	3.745- 9	3.117- 8	2.656- 8	2.251- 9	1.370- 8	1.534-11
2	1.332- 2	3.357- 3	6.695- 4	1.129- 4	1.538- 5	8.371- 7	3.371-10	8.394- 8	4.193- 8	3.752- 8	1.847- 8	6.247- 9
3	9.362- 2	3.436- 2	1.075- 2	2.566- 3	4.859- 4	6.925- 5	5.098- 6	1.534- 7	1.463- 7	7.928- 8	7.525- 9	9.868-11
4	1.484- 1	1.268- 1	5.862- 2	2.633- 2	7.508- 3	1.592- 3	2.420- 4	2.618- 5	3.839- 6	1.208- 6	1.283- 7	1.823- 7
5	1.840- 2	1.874- 1	1.460- 1	1.075- 1	5.164- 2	1.710- 2	4.212- 3	7.988- 4	1.226- 4	1.907- 5	2.234- 6	3.155-10

Table 75

RKR FRANCK-CONDON FACTORS FOR (V) GAMMA PRIME (1/2)

V	VV 0	1	2	3	4	5	6	7	8	9	10	11
0	1.913- 1	2.795- 1	2.320- 1	1.441- 1	7.795- 2	3.975- 2	1.935- 2	8.975- 3	3.923- 3	1.599- 3	6.1[illegible]- 4	2.144- 4
1	3.423- 1	4.021- 2	5.774- 3	9.124- 2	1.411- 1	1.290- 1	9.100- 2	5.494- 2	2.993- 2	1.511- 2	7.229- 3	3.293- 3
2	2.753- 1	3.851- 2	1.717- 1	8.235- 2	2.509- 4	4.647- 2	9.715- 2	1.051- 1	8.359- 2	5.582- 2	3.369- 2	1.911- 2
3	1.366- 1	2.101- 1	2.953- 2	6.079- 2	1.173- 1	3.834- 2	2.910- 4	3.352- 2	7.366- 2	4.553- 2	7.412- 2	5.457- 2
4	4.371- 2	2.333- 1	5.439- 2	1.138- 1	9.650- 5	7.455- 2	8.398- 2	2.192- 2	1.131- 3	2.925- 2	6.093- 2	7.491- 2
5	9.881- 3	1.169- 1	2.221- 1	6.896- 4	1.156- 1	3.384- 2	1.395- 2	7.578- 2	5.924- 2	1.104- 2	2.172- 3	2.073- 2

V	VV 12	13	14	15	16	17	18	19	20	21	22	23
0	7.068- 5	2.138- 3	6.552- 6	2.339- 6	1.111- 6	6.559- 7	4.136- 7	2.185- 7	7.662- 8	1.061- 8	6.508-10	8.431- 9
1	1.382- 3	5.411- 4	2.026- 4	7.427- 5	2.738- 5	1.015- 5	3.819- 6	1.676- 6	8.237- 7	4.796- 7	3.121- 7	1.992- 7
2	9.374- 3	4.826- 3	2.174- 3	9.243- 4	3.734- 4	1.521- 4	5.191- 5	2.389- 5	1.248- 5	6.276- 6	3.392- 6	1.452- 6
3	3.520- 2	2.071- 2	1.143- 2	5.975- 3	2.986- 3	1.493- 3	5.278- 4	2.795- 4	1.238- 4	5.758- 5	2.847- 5	1.359- 5
4	6.729- 2	5.103- 2	3.432- 2	2.163- 2	1.291- 2	7.254- 3	3.844- 3	1.939- 3	9.176- 4	4.216- 4	1.936- 4	8.695- 5
5	5.323- 2	5.392- 2	5.907- 2	4.763- 2	3.439- 2	2.278- 2	1.392- 2	8.129- 3	4.655- 3	2.339- 3	1.189- 3	5.751- 4

Table 76

RKR FRANCK-CONDON FACTORS FOR (NO GAMMA PRIME (3/2))

V V	0	1	2	3	4	5	6	7	8	9	10	11
0	1.808-1	2.703-1	2.287-1	1.505-1	8.563-2	4.417-2	2.146-2	9.933-3	4.348-3	1.803-3	7.138-4	2.701-4
1	3.371-1	9.533-2	2.444-3	7.886-2	1.368-1	1.303-1	9.454-2	5.884-2	3.302-2	1.715-2	8.363-3	3.814-3
2	2.810-1	2.352-2	1.644-1	7.209-2	1.334-4	3.749-2	9.951-2	1.041-1	8.728-2	6.038-2	3.724-2	2.112-2
3	1.430-1	2.093-1	3.790-2	4.765-2	1.162-1	4.581-2	8.520-5	2.621-2	6.778-2	8.451-2	7.642-2	5.729-2
4	4.656-2	2.350-1	5.310-2	1.200-1	3.683-4	6.446-2	9.587-2	2.754-2	5.881-5	2.279-2	5.572-2	7.185-2
5	9.574-3	1.223-1	2.191-1	6.136-5	1.104-1	4.085-2	9.113-3	6.921-2	6.336-2	1.600-2	5.376-4	2.099-2

V V	12	13	14	15	16	17	18	19	20	21	22	23
0	9.816-3	3.425-3	1.129-3	3.373-6	8.909-7	2.134-7	5.247-8	2.374-9	2.469-8	3.370-8	4.007-8	3.729-8
1	1.624-3	6.490-4	2.473-4	9.030-5	3.250-5	1.187-5	4.436-6	1.781-6	8.177-7	4.345-7	2.616-7	1.651-7
2	1.115-2	5.497-3	2.538-3	1.095-3	4.526-4	1.857-4	7.547-5	3.232-5	1.416-5	6.229-6	2.762-6	1.254-6
3	3.734-2	2.301-2	1.303-2	6.874-3	3.411-3	1.616-3	7.280-4	3.214-4	1.427-4	6.415-5	2.933-5	1.348-5
4	6.842-2	5.410-2	3.790-2	2.407-2	1.427-2	8.070-3	4.303-3	2.175-3	1.050-3	4.918-4	2.227-4	1.011-4
5	4.836-2	6.274-2	6.158-2	5.041-2	3.652-2	2.452-2	1.531-2	9.025-3	5.102-3	2.708-3	1.358-3	6.523-4

Table 77 RKR FRANCK-CONDON FACTORS FOR (NO HEATH)

VV V	J	1	2	3	4	5
J	9.996- 1	2.793- 3	1.961- 4	5.971- 5	6.195- 7	1.838- 7
1	2.159- 3	9.976- 1	1.223- 3	2.543- 4	2.255- 4	2.414- 5
2	1.862- 4	1.090- 3	9.953- 1	6.631- 3	4.939- 4	5.535- 4
3	8.550- 5	2.566- 4	5.732- 3	9.711- 1	2.030- 2	6.335- 4
4	5.481- 6	2.701- 4	5.904- 4	1.714- 2	9.334- 1	4.551- 2

Table 78 RKR FRANCK-CONDON FACTORS FOR (NO FEAST 1)

VV V	0	1	2	3	4	5
0	9.989- 1	1.138- 4	3.133- 4	1.547- 5	1.541- 5	4.517- 6
1	2.159- 3	9.987- 1	1.107- 4	4.139- 4	4.791- 5	7.452- 6
2	3.078- 4	1.204- 4	9.994- 1	2.156- 3	4.115- 4	1.175- 7
3	1.449- 5	4.201- 4	2.244- 3	9.978- 1	3.140- 4	1.929- 4
4	2.184- 6	6.819- 6	4.122- 4	5.257- 4	9.958- 1	1.614- 3
5	4.705- 6	7.338- 6	2.919- 6	1.897- 4	1.352- 3	9.917- 1
6	1.176- 8	8.656- 6	2.704- 5	2.852- 5	6.498- 5	1.359- 3
7	6.763-10	4.287- 6	1.635- 5	9.836- 5	4.992- 5	1.593- 3

Table 79 RKR FRANCK-CONDON FACTORS FOR (NO FEAST 2)

VV V	0	1	2	3	4	5
0	9.962- 1	2.659- 3	4.136- 4	4.854- 5	2.315- 5	2.052- 5
1	2.766- 3	9.933- 1	3.173- 3	3.931- 5	2.573- 5	1.556- 5
2	2.808- 4	3.315- 3	9.914- 1	4.729- 3	7.833- 6	2.774- 6
3	7.787- 5	1.976- 6	4.669- 3	9.871- 1	7.415- 3	1.442- 5
4	1.875- 5	3.150- 5	8.489- 5	7.224- 3	9.833- 1	8.615- 3
5	2.476- 5	6.661- 5	5.343- 7	1.435- 4	9.353- 3	9.832- 1

Table 80 RKR FRANCK-CONDON FACTORS FOR (NO E - C)

VV	0	1	2	3	4
V					
0	9.963-1	2.232-3	5.828-4	2.265-4	4.371-5
1	2.233-3	9.959-1	2.183-4	2.884-4	3.983-4
2	5.363-4	5.357-4	9.971-1	1.189-4	1.573-4
3	2.374-4	2.291-4	1.583-4	9.938-1	2.533-3
4	8.181-5	4.048-4	2.211-4	3.175-3	9.785-1
5	1.299-5	1.863-5	8.894-4	4.494-4	1.454-2

Table 81 RKR FRANCK-CONDON FACTORS FOR (NO FEAST-HEATH)

V' \ V	0	1	2	3	4	5	6	7
0	9.955- 1	3.824- 3	1.002- 5	1.891- 5	1.058- 5	9.104- 6	1.342- 8	1.224- 6
1	3.941- 3	9.906- 1	4.633- 3	2.224- 4	1.553- 5	4.381- 7	1.021- 5	5.776- 9
2	1.449- 6	4.501- 3	9.899- 1	4.224- 3	5.245- 4	1.025- 6	1.661- 5	1.012- 7
3	1.297- 9	3.837- 4	3.955- 3	9.915- 1	3.884- 3	4.433- 4	1.304- 7	9.032- 5
4	7.118- 6	1.905- 6	8.360- 4	3.499- 3	9.912- 1	2.966- 3	4.309- 5	1.303- 6
5	3.460- 6	2.954- 7	3.128- 5	5.556- 4	2.697- 3	9.989- 1	2.334- 3	6.140- 4

Table 82

RKR FRANCK-CONDON FACTORS FOR (NO L - M)

v'' \ v'	0	1	2	3	4	5	6	7	8	9	10	11
0	3.521- 3	2.233- 2	6.836- 2	1.362- 1	1.924- 1	2.034- 1	1.656- 1	1.134- 1	5.954- 2	2.662- 2	1.013- 2	3.242- 3
1	1.586- 2	6.968- 2	1.333- 1	1.293- 1	5.534- 2	7.420- 4	3.304- 2	1.111- 1	1.531- 1	1.372- 1	9.083- 2	4.534- 2
2	3.844- 2	1.114- 1	1.030- 1	2.602- 2	7.208- 3	7.434- 2	8.838- 2	2.570- 2	3.166- 3	6.307- 2	1.305- 1	1.395- 1
3	6.636- 2	1.192- 1	4.125- 2	4.430- 3	6.873- 2	5.647- 2	8.347- 4	3.981- 2	8.373- 2	3.857- 2	1.095- 4	4.421- 2
4	9.145- 2	8.955- 2	1.618- 3	4.887- 2	5.641- 2	3.638- 4	4.425- 2	5.899- 2	3.797- 3	2.951- 2	7.754- 2	3.790- 2
5	1.069- 1	4.754- 2	1.111- 2	6.681- 2	7.844- 3	2.975- 2	5.195- 2	1.136- 3	3.848- 2	3.448- 2	2.747- 3	3.150- 2
6	1.096- 1	1.469- 2	4.874- 2	3.987- 2	5.914- 3	5.326- 2	6.386- 3	2.778- 2	4.549- 2	2.153- 4	4.117- 2	4.531- 2
7	1.006- 1	8.866- 4	5.778- 2	8.927- 3	3.481- 2	2.738- 2	8.889- 3	4.528- 2	2.529- 3	3.194- 2	3.584- 2	6.456- 4

v'' \ v'	12	13	14	15	16	17	18	19	20	21	22	23
0	8.682- 4	1.724- 4	2.513- 5	4.710- 6	1.251- 6	5.497- 8	9.237- 9	5.750- 9	1.999- 9	5.346- 9	2.554- 9	1.078- 9
1	1.839- 2	5.789- 3	1.459- 3	3.884- 4	5.758- 5	1.825- 5	8.394- 7	2.510-10	8.796- 9	4.871- 8	5.905-14	2.356- 8
2	1.885- 1	5.206- 2	2.857- 2	6.543- 3	1.648- 3	3.398- 4	5.581- 5	5.212- 6	5.289- 7	4.898- 7	5.896- 9	1.857- 7
3	1.212- 1	1.364- 1	9.768- 2	3.069- 2	1.931- 2	5.714- 3	1.351- 3	2.547- 4	3.931- 5	4.211- 6	3.787- 7	3.563- 8
4	1.865- 4	5.859- 2	1.219- 1	1.337- 1	8.969- 2	4.281- 2	1.367- 2	4.326- 3	9.319- 4	1.547- 4	2.815- 5	3.415- 6
5	7.457- 2	2.948- 2	2.221- 3	6.446- 2	1.208- 1	1.243- 1	7.885- 2	3.397- 2	1.118- 2	2.887- 3	5.681- 4	8.852- 5
6	2.496- 4	4.132- 2	6.976- 2	1.686- 2	9.971- 3	8.362- 2	1.349- 1	1.128- 1	6.334- 2	2.628- 2	7.868- 3	1.782- 3
7	4.686- 2	3.334- 2	1.188- 3	5.381- 2	5.929- 2	5.388- 3	2.465- 2	1.821- 1	1.358- 1	1.834- 1	5.259- 2	1.965- 2

Table 83

RKR FRANCK-CONDON FACTORS FOR (O(2) S-R)

V \ V'	0	1	2	3	4	5	6	7	8	9	10	11
0	3.547-9	1.021-7	1.430-6	1.283-5	8.264-5	4.037-4	1.538-3	5.145-3	1.352-2	3.038-2	5.765-2	9.277-2
1	3.449-8	9.090-7	1.142-5	9.071-5	5.105-4	2.157-3	7.154-3	1.875-2	3.910-2	6.537-2	8.637-2	8.593-2
2	2.143-7	5.050-6	5.697-5	4.035-4	1.953-3	7.109-3	1.951-2	4.087-2	6.457-2	7.475-2	5.774-2	2.167-2
3	9.135-7	1.954-5	1.979-4	1.231-3	5.243-3	1.610-2	3.523-2	5.900-2	6.621-2	4.494-2	1.090-2	1.697-3
4	2.914-6	5.680-5	5.162-4	2.842-3	1.049-2	2.710-2	4.904-2	5.935-2	4.172-2	9.056-3	2.093-3	2.461-2
5	7.663-6	1.361-4	1.113-3	5.419-3	1.726-2	3.713-2	5.255-2	4.372-2	1.390-2	4.503-4	2.222-2	3.547-2
6	1.733-5	2.811-4	2.071-3	8.921-3	2.445-2	4.323-2	4.503-2	2.251-2	5.658-4	1.264-2	3.386-2	1.985-2
7	3.498-5	5.199-4	3.458-3	1.317-2	3.092-2	4.420-2	3.326-2	6.545-3	3.409-3	2.597-2	2.552-2	2.222-3
8	6.299-5	8.594-4	5.173-3	1.744-2	3.498-2	3.942-2	1.891-2	1.395-4	1.355-2	2.764-2	9.543-3	2.026-3
9	1.008-4	1.269-3	6.938-3	2.074-2	3.527-2	3.072-2	7.555-3	2.009-3	2.092-2	1.905-2	6.325-4	1.153-2
10	1.477-4	1.724-3	8.608-3	2.292-2	3.306-2	2.145-2	1.590-3	7.528-3	2.197-2	8.797-3	1.391-3	1.793-2
11	1.963-4	2.136-3	9.789-3	2.331-2	2.847-2	1.314-2	1.057-7	1.219-2	1.776-2	2.101-3	6.439-3	1.687-2
12	2.399-4	2.449-3	1.038-2	2.225-2	2.307-2	7.126-3	3.339-4	1.417-2	1.190-2	2.047-5	1.045-2	1.161-2
13	2.699-4	2.604-3	1.028-2	2.002-2	1.768-2	3.355-3	2.570-3	1.351-2	5.770-3	6.809-4	1.152-2	6.186-3
14	2.807-4	2.580-3	9.579-3	1.711-2	1.299-2	1.339-3	3.813-3	1.155-2	3.330-3	2.051-3	1.027-2	2.572-3
15	2.723-4	2.403-3	8.468-3	1.405-2	9.298-3	4.292-4	4.325-3	9.059-3	1.430-3	3.014-3	8.083-3	7.935-4
16	2.481-4	2.113-3	7.151-3	1.115-2	6.523-3	9.258-5	4.214-3	6.749-3	5.290-4	3.323-3	5.902-3	1.417-4
17	2.125-4	1.765-3	5.764-3	8.542-3	4.505-3	5.822-6	3.694-3	4.839-3	1.609-4	3.110-3	4.101-3	1.667-6
18	1.736-4	1.414-3	4.495-3	6.402-3	3.101-3	3.486-6	3.029-3	3.410-3	3.630-5	2.643-3	2.793-3	2.395-5
19	1.349-4	1.082-3	3.371-3	4.658-3	2.110-3	1.685-5	2.342-3	2.354-3	3.894-5	2.085-3	1.867-3	6.360-5
20	8.805-5	6.991-4	2.147-3	2.905-3	1.253-3	2.134-5	1.519-3	1.410-3	3.432-8	1.367-3	1.090-3	6.998-5

Table 83 (cont'd)

(3(2) S-2)

VV	12	13	14	15	16	17	18	19	20	21	22	23
0	1.275-1	1.504-1	1.519-1	1.32J-1	9.974-2	6.595-2	3.823-2	1.934-2	8.476-3	3.238-3	1.131-3	3.809-4
1	5.850-2	1.973-2	1.965-5	1.946-2	6.821-2	1.143-1	1.311-1	1.159-1	8.112-2	4.730-2	2.381-2	1.090-2
2	9.873-5	1.916-2	5.757-2	7.123-2	4.128-2	4.673-3	9.838-3	5.537-2	1.835-1	1.185-1	1.016-1	7.286-2
3	2.948-2	5.375-2	3.585-2	3.265-3	1.161-2	5.294-2	5.424-2	2.839-2	1.855-2	2.278-2	7.785-2	1.247-1
4	4.399-2	1.953-2	9.664-5	2.553-2	5.830-2	2.562-2	1.548-5	2.713-2	6.181-2	4.458-2	5.579-3	1.261-2
5	1.650-2	4.18J-4	2.567-2	3.905-2	1.042-2	4.610-3	3.960-2	4.045-2	5.218-3	1.083-2	5.024-2	5.355-2
6	1.098-5	1.925-2	3.309-2	7.831-3	5.859-3	3.533-2	2.455-2	2.013-5	2.637-2	4.437-2	1.291-2	4.958-3
7	1.018-2	2.951-2	1.079-2	2.827-3	2.893-2	2.053-2	9.678-5	2.641-2	3.258-2	2.565-3	1.487-2	4.147-2
8	2.289-2	1.683-2	5.783-5	2.006-2	2.179-2	1.948-4	1.917-2	2.695-2	1.271-3	1.093-2	3.355-2	5.264-3
9	2.132-2	2.657-3	8.799-3	2.279-2	3.439-3	9.299-3	2.494-2	3.387-3	1.111-2	2.883-2	5.038-3	1.004-2
10	1.125-2	5.03J-4	1.753-2	1.120-2	1.162-3	2.005-2	9.571-3	3.071-3	2.396-2	8.444-3	4.573-3	2.537-2
11	2.768-3	6.113-3	1.647-2	1.611-3	9.065-3	1.009-2	1.835-4	1.433-2	1.432-2	2.637-4	1.898-2	1.171-2
12	1.355-5	1.085-2	9.787-3	3.250-4	1.375-2	6.591-3	2.856-3	1.642-2	2.548-3	8.232-3	1.718-2	3.825-4
13	1.061-3	1.161-2	3.783-3	3.265-3	1.222-2	9.511-4	9.039-3	1.040-2	1.833-4	1.378-2	6.924-3	2.689-3
14	2.952-3	9.549-3	7.701-4	5.831-3	7.936-3	8.035-5	9.935-3	4.175-3	3.015-3	1.200-2	8.901-4	7.745-3
15	4.109-3	6.734-3	7.226-6	6.552-3	4.254-3	1.103-3	9.537-3	9.585-4	5.448-3	7.475-3	1.145-4	9.114-3
16	4.315-3	4.341-3	1.838-4	5.925-3	1.939-3	2.188-3	5.195-3	4.037-5	5.988-3	3.763-3	1.228-3	7.607-3
17	3.866-3	2.647-3	4.926-4	4.715-3	7.722-4	2.555-3	4.856-3	9.117-5	5.216-3	1.618-3	2.128-3	5.319-3
18	3.166-3	1.588-3	6.641-4	3.517-3	2.737-4	2.414-3	2.549-3	2.938-4	4.058-3	6.205-4	2.371-3	3.425-3
19	2.424-3	9.462-4	5.741-4	2.502-3	9.452-5	2.013-3	1.535-3	4.135-4	2.942-3	2.130-4	2.142-3	2.112-3
20	1.555-3	5.023-4	5.107-4	1.521-3	2.048-5	1.354-3	9.478-4	3.637-4	1.801-3	6.051-5	1.506-3	1.139-3

Table 84 RKR FRANCK-CONDON FACTOR FOR (N2 PHOTO 1)

VV V	0	1	2	3	4	5	6	7	8	9	10
0	9.039- 1	9.274- 2	3.310- 3	4.414- 5	4.072- 7	6.058- 9	8.334-12	7.836-12	2.122-12	7.692-13	2.349-13
1	8.956- 2	7.291- 1	1.714- 1	9.792- 3	1.897- 4	2.366- 5	4.187- 8	6.036-11	7.805-11	2.051-11	7.348-12
2	8.164- 3	1.596- 1	5.771- 1	2.372- 1	1.937- 2	5.119- 4	8.252- 6	1.706- 7	2.186-10	4.046-10	1.137-10
3	3.605- 4	1.709- 2	2.139- 1	4.454- 1	2.910- 1	3.202- 2	1.110- 3	2.241- 5	5.340- 7	5.525-10	1.565- 9
4	1.748- 5	1.375- 3	3.167- 2	2.513- 1	3.323- 1	3.333- 1	4.758- 2	2.111- 3	5.219- 5	1.423- 6	1.034- 9
5	5.822- 7	8.796- 5	3.294- 3	4.398- 2	2.758- 1	2.366- 1	3.542- 1	6.638- 2	3.679- 3	1.095- 4	3.393- 6
6	5.933- 9	3.996- 6	2.666- 4	6.337- 3	6.821- 2	2.899- 1	1.576- 1	3.838- 1	8.771- 2	6.015- 3	2.129- 4
7	2.902-10	9.195- 8	1.586- 5	6.306- 4	1.070- 2	8.856- 2	2.917- 1	9.492- 2	3.921- 1	1.117- 1	9.367- 3
8	1.106-10	1.008-10	5.389- 7	4.729- 5	1.291- 3	1.655- 2	1.092- 1	2.830- 1	4.838- 2	3.891- 1	1.377- 1
9	3.046-13	3.140-10	3.199- 9	2.391- 6	1.197- 4	2.347- 3	2.460- 2	1.232- 1	2.649- 1	1.767- 2	3.758- 1
10	2.525-11	2.705-11	8.385-11	5.993- 8	8.258- 6	2.657- 4	3.991- 3	3.314- 2	1.475- 1	2.384- 1	2.265- 3
11	2.965-11	2.695-10	4.348-11	1.737- 9	4.092- 7	2.390- 5	5.372- 4	6.354- 3	4.392- 2	1.629- 1	2.352- 1
12	1.942-11	3.151-10	1.655- 9	3.638- 9	3.097- 8	1.820- 5	5.066- 5	1.009- 3	9.092- 3	5.620- 2	1.744- 1
13	1.007-11	2.239-10	1.883- 9	7.505- 9	2.098- 8	2.065- 7	6.317- 6	1.389- 4	1.784- 3	1.417- 2	6.964- 2
14	4.762-12	1.288-11	1.405- 9	8.109- 9	2.833- 8	9.458- 8	9.217- 7	1.846- 5	2.925- 4	2.995- 3	1.996- 2
15	2.242-12	6.710-11	8.625-10	6.302- 9	2.908- 8	9.397- 8	3.558- 7	3.245- 5	4.750- 5	5.745- 4	4.918- 3
16	1.105-12	3.358-11	4.828-10	4.102- 9	2.332- 8	9.805- 9	2.825- 7	1.153- 6	9.704- 5	1.105- 4	1.003- 3
17	5.712-13	1.680-11	2.612-10	2.492- 9	1.638- 8	7.329- 9	2.513- 7	7.845- 7	3.396- 6	2.565- 5	2.366- 4
18	2.989-13	8.692-12	1.414-10	1.438- 9	1.028- 8	5.273- 8	2.052- 7	6.474- 7	2.037- 5	9.828- 6	6.147- 5
19	1.531-13	4.762-12	7.827-11	8.258-10	6.226- 9	3.519- 8	1.326- 7	5.247- 7	1.565- 6	4.995- 6	2.208- 5
20	7.727-14	2.779-12	4.486-11	4.798-10	3.759- 9	2.258- 8	1.862- 7	3.993- 7	1.247- 6	3.581- 6	1.155- 5

Table 84 (cont'd)

(N2 PHOTO 1)

V V	11	12	13	14	15	16	17	18	19	20
0	5.287-14	1.278-14	1.015-14	1.016-14	1.017-14	1.018-14	1.019-14	1.020-14	1.022-14	1.024-14
1	2.502-12	9.375-13	3.443-13	1.151-13	3.938-14	1.840-14	1.154-14	1.021-14	1.023-14	1.025-14
2	4.285-11	1.595-11	5.812-12	2.287-12	8.977-13	3.958-13	1.879-13	9.038-14	3.882-14	1.241-14
3	4.533-10	1.791-10	7.068-11	2.789-11	1.151-11	4.958-12	2.198-12	9.691-13	4.061-13	1.546-13
4	4.895- 9	1.465- 9	6.068-10	2.537-10	1.066-10	4.577-11	1.995-11	8.720-12	3.762-12	1.535-12
5	1.269- 9	1.327- 8	4.090- 9	1.770- 9	7.739-10	3.372-10	1.481-10	6.573-11	2.855-11	1.181-11
6	7.464- 0	9.620-10	3.221- 8	1.013- 8	4.533- 9	2.054- 9	9.245-10	4.134-10	1.816-10	7.887-11
7	3.906- 4	1.544- 5	1.213-11	7.136- 8	2.270- 8	1.047- 8	4.938- 9	2.231- 9	1.004- 9	4.353-10
8	1.402- 2	6.841- 4	3.038- 5	3.111- 9	1.468- 7	4.640- 8	2.208- 8	1.034- 8	4.785- 9	2.153- 9
9	1.653- 1	2.032- 2	1.153- 3	5.736- 5	2.855- 6	2.839- 7	8.795- 9	4.252- 8	2.015- 8	9.274- 9
10	3.505- 1	1.934- 1	2.860- 2	1.882- 3	1.046- 4	1.330- 7	5.194- 7	1.545- 7	7.393- 8	3.573- 8
11	1.235- 3	3.104- 1	2.210- 1	3.925- 2	2.936- 3	1.851- 4	4.539- 7	9.041- 7	2.525- 7	1.249- 7
12	1.672- 1	1.303- 2	2.744- 1	2.466- 1	5.259- 2	4.622- 3	3.197- 4	1.370- 6	1.505- 6	3.853- 7
13	1.806- 1	1.269- 1	3.537- 2	2.265- 1	2.685- 1	5.859- 2	6.992- 3	5.351- 4	3.598- 6	2.388- 6
14	8.366- 2	1.803- 1	8.729- 2	6.513- 2	1.757- 1	2.851- 1	8.828- 2	1.035- 2	8.773- 4	8.538- 6
15	2.721- 2	9.745- 2	1.729- 1	5.175- 2	9.843- 2	1.254- 1	2.343- 1	1.106- 1	1.501- 2	1.402- 3
16	7.416- 3	3.591- 2	1.099- 1	1.580- 1	2.356- 2	1.318- 1	7.929- 2	2.948- 1	1.356- 1	2.130- 2
17	1.865- 3	1.181- 2	4.591- 2	1.198- 1	1.302- 1	5.551- 3	1.577- 1	4.123- 2	2.853- 1	1.624- 1
18	4.724- 4	3.119- 3	1.577- 2	5.682- 2	1.255- 1	1.859- 1	2.594- 3	1.747- 1	1.457- 2	2.663- 1
19	1.357- 4	8.959- 4	4.996- 3	2.181- 2	5.796- 2	1.258- 1	7.851- 2	7.214- 3	1.785- 1	1.444- 3
20	5.029- 5	2.789- 4	1.575- 3	7.653- 3	2.909- 2	7.829- 2	1.196- 1	4.876- 2	2.593- 2	1.673- 1

Table 85

RKR FRANCK-CONDON FACTOR FOR (N2 PHOTO 2)

V' \ V	0	1	2	3	4	5	6	7	8	9	10
0	2.726- 1	3.827- 1	2.360- 1	8.499- 2	2.000- 2	3.265- 3	3.845- 4	3.336- 5	2.061- 6	9.301- 8	3.346- 9
1	3.197- 1	2.549- 2	1.126- 1	2.712- 1	1.870- 1	6.733- 2	1.509- 2	2.290- 3	2.417- 4	1.802- 5	9.250- 7
2	2.155- 1	5.454- 2	1.577- 1	7.561- 5	1.593- 1	2.354- 1	1.299- 1	3.944- 2	7.557- 3	9.743- 4	8.653- 5
3	1.116- 1	1.584- 1	9.216- 3	1.346- 1	5.280- 2	4.216- 2	2.094- 1	1.850- 1	7.622- 2	1.843- 2	2.876- 3
4	4.953- 2	1.598- 1	3.709- 2	8.140- 2	4.159- 2	1.198- 1	5.913- 6	1.346- 1	2.116- 1	1.202- 1	3.668- 2
5	2.001- 2	1.084- 1	1.102- 1	8.607- 4	1.138- 1	3.672- 5	1.218- 1	2.946- 2	5.521- 2	2.000- 1	1.619- 1
6	7.625- 3	5.959- 2	1.237- 1	3.487- 2	3.950- 2	7.658- 2	2.555- 2	7.127- 2	8.056- 2	7.281- 3	1.556- 1
7	2.808- 3	2.898- 2	9.442- 2	8.862- 2	3.244- 4	8.133- 2	2.215- 2	7.258- 2	1.838- 2	1.111- 1	3.622- 3
8	1.015- 3	1.293- 2	5.845- 2	1.005- 1	3.493- 2	1.697- 2	8.192- 2	2.807- 5	9.067- 2	9.877- 5	1.020- 1
9	3.641- 4	5.513- 3	3.183- 2	8.146- 2	7.451- 2	2.724- 3	5.250- 2	4.755- 2	1.844- 2	6.992- 2	1.959- 2
10	1.305- 4	2.280- 3	1.596- 2	5.443- 2	8.429- 2	3.472- 2	6.023- 3	7.057- 2	1.146- 2	5.197- 2	3.125- 2
11	4.703- 5	9.270- 4	7.581- 3	3.221- 2	7.083- 2	6.474- 2	5.589- 3	3.173- 2	5.824- 2	3.007- 4	7.006- 2
12	1.709- 5	3.736- 4	3.478- 3	1.759- 2	5.000- 2	7.223- 2	3.372- 2	1.495- 3	5.463- 2	2.850- 2	1.649- 2
13	6.283- 6	1.501- 4	1.561- 3	9.098- 3	3.155- 2	5.226- 2	5.532- 2	8.139- 3	1.839- 2	5.706- 2	4.583- 3
14	2.342- 6	6.039- 5	6.912- 4	4.539- 3	1.845- 2	4.591- 2	6.281- 2	3.199- 2	1.139- 4	4.014- 2	3.901- 2
15	8.851- 7	2.440- 5	3.038- 4	2.210- 3	1.024- 2	3.053- 2	5.531- 2	5.029- 2	9.614- 3	1.044- 2	5.023- 2
16	3.385- 7	9.920- 6	1.331- 4	1.059- 3	5.479- 3	1.891- 2	4.232- 2	5.518- 2	2.969- 2	6.662- 5	2.899- 2
17	1.305- 7	4.063- 6	5.825- 5	5.021- 4	2.859- 3	1.114- 2	2.945- 2	4.958- 2	4.448- 2	1.019- 2	5.971- 3
18	5.040- 8	1.676- 6	2.555- 5	2.306- 4	1.466- 3	6.335- 3	1.918- 2	3.921- 2	4.879- 2	2.698- 2	3.886- 4
19	1.942- 8	6.949- 7	1.123- 5	1.111- 4	7.424- 4	3.511- 3	1.191- 2	2.842- 2	4.472- 2	3.921- 2	9.949- 3
20	7.435- 9	2.886- 7	4.952- 6	5.205- 5	3.729- 4	1.910- 3	7.141- 3	1.934- 2	3.646- 2	4.319- 2	2.393- 2

Table 85 (cont'd)

V \ VV	11	12	13	14	15	16	17	18	19	20
0	2.543-10	5.037-12	4.259-12	5.291-12	4.372-14	5.250-13	3.745-13	4.152-14	1.027-14	9.086-14
1	3.881- 8	1.659- 9	6.307-12	6.770-12	2.336-11	3.570-13	5.044-12	2.353-12	7.549-14	8.626-13
2	5.306- 6	2.402- 7	8.292- 9	1.162-11	1.026-14	3.074-11	5.110-12	3.372-12	6.258-12	4.703-13
3	3.015- 4	2.153- 5	1.083- 6	3.864- 8	3.480-10	5.631-12	3.983-11	1.019-11	3.251-12	1.093-11
4	6.901- 3	8.495- 4	7.007- 5	3.954- 6	1.518- 7	2.510- 9	5.205-11	3.719-11	1.420-11	8.207-13
5	6.272- 2	1.422- 2	2.049- 3	1.941- 4	1.233- 5	5.214- 7	1.131- 8	2.357-10	4.709-11	2.242-11
6	1.909- 1	9.301- 2	2.602- 2	4.380- 3	4.754- 4	3.394- 5	1.588- 5	4.158- 8	8.148-10	6.189-11
7	9.519- 2	1.958- 1	1.298- 1	4.311- 2	8.483- 3	1.053- 3	8.447- 5	4.374- 6	1.317- 7	2.584- 9
8	3.359- 2	3.971- 2	1.826- 1	1.515- 1	5.562- 2	1.512- 2	2.144- 3	1.931- 4	1.106- 5	3.703- 7
9	6.412- 2	7.330- 2	6.165- 3	1.458- 1	1.841- 1	9.259- 2	2.516- 2	4.051- 3	4.104- 4	2.584- 5
10	5.440- 2	2.233- 2	9.925- 2	1.714- 3	9.751- 2	1.323- 1	1.219- 1	3.834- 2	7.219- 3	8.161- 4
11	3.782- 3	7.728- 2	1.110- 3	9.896- 2	2.214- 2	5.037- 2	1.934- 1	1.511- 1	5.706- 2	1.211- 2
12	6.053- 2	3.258- 3	7.392- 2	6.722- 3	7.459- 2	5.462- 2	1.515- 2	1.579- 1	1.736- 1	7.920- 2
13	4.243- 2	3.284- 2	2.481- 2	4.873- 2	3.165- 2	3.955- 2	8.344- 2	3.377- 4	1.206- 1	1.885- 1
14	1.587- 3	5.593- 2	7.491- 3	5.020- 2	1.867- 2	5.870- 2	1.058- 2	9.617- 2	6.694- 3	7.894- 2
15	1.473- 2	1.770- 2	5.025- 2	3.402- 4	5.159- 2	1.244- 3	7.131- 2	1.958- 7	8.808- 2	2.843- 2
16	4.234- 2	7.312- 4	3.837- 2	2.855- 2	1.311- 2	5.240- 2	4.409- 3	6.474- 2	9.828- 3	6.348- 2
17	4.209- 2	2.291- 2	4.500- 3	4.798- 2	7.366- 3	3.444- 2	2.972- 2	2.335- 2	4.217- 2	3.254- 2
18	2.116- 2	4.112- 2	5.266- 3	2.076- 2	4.036- 2	7.736- 5	4.895- 2	8.125- 3	4.486- 2	1.678- 2
19	3.593- 3	3.473- 2	2.734- 2	2.375- 4	3.654- 2	2.152- 2	9.526- 3	4.783- 2	9.538- 6	5.566- 2
20	6.358- 4	1.599- 2	3.778- 2	1.015- 2	9.334- 3	4.350- 2	4.730- 3	2.732- 2	3.088- 2	8.415- 3

Table 86

RKR FRANCK-CONDON FACTOR FOR (N2 PHOTO 3)

V V	0	1	2	3	4	5	6	7	8	9	10
0	8.843- 1	1.027- 1	1.150- 2	1.279- 3	1.595- 4	2.364- 5	4.335- 6	9.359- 7	2.685- 7	9.332- 8	2.927- 8
1	1.131- 1	6.854- 1	1.567- 1	2.943- 2	4.518- 3	7.257- 4	1.323- 4	2.831- 5	7.536- 6	2.297- 6	7.868- 7
2	2.579- 3	2.453- 1	5.296- 1	2.062- 1	4.989- 2	9.873- 3	1.977- 3	4.333- 4	1.098- 4	3.240- 5	1.092- 5
3	3.851- 7	6.563- 3	2.812- 1	4.090- 1	2.134- 1	6.995- 2	1.716- 2	4.159- 3	1.071- 3	3.110- 4	1.026- 4
4	2.518- 5	1.260- 5	1.093- 2	3.448- 1	3.171- 1	2.030- 1	8.752- 2	2.595- 2	7.438- 3	2.215- 3	7.283- 4
5	3.210- 9	1.440- 5	9.047- 5	1.479- 2	3.992- 1	2.481- 1	1.829- 1	1.012- 1	3.513- 2	1.135- 2	4.038- 3
6	1.796- 9	3.202-10	4.706- 5	3.728- 4	1.739- 2	4.469- 1	1.974- 1	1.543- 1	1.104- 1	4.403- 2	1.728- 2
7	4.214-11	2.466- 8	7.227- 8	1.134- 4	1.138- 3	1.813- 2	4.894- 1	1.613- 1	1.208- 1	1.150- 1	5.148- 2
8	3.532-14	3.446-11	1.536- 7	1.132- 6	2.182- 4	2.864- 3	1.553- 2	5.258- 1	1.365- 1	8.556- 2	1.155- 1
9	8.700-12	1.173-11	6.336-10	6.295- 7	7.476- 6	3.425- 4	5.282- 3	1.295- 2	5.579- 1	1.207- 1	5.206- 2
10	1.566-12	5.711-11	8.754-11	2.039- 8	1.840- 6	3.322- 5	4.256- 4	1.237- 2	7.434- 3	5.798- 1	1.118- 1
11	1.028-14	3.343-11	2.775-10	3.382-10	1.903- 7	3.869- 5	1.144- 4	3.765- 4	2.221- 2	2.091- 3	5.873- 1
12	1.029-14	6.572-12	2.240-10	4.809-10	4.156-10	1.093- 5	5.331- 6	3.245- 4	1.488- 4	3.659- 2	9.536- 5
13	1.743-13	6.510-13	2.959-11	7.595-10	9.830-11	8.239-11	4.373- 6	2.842- 5	7.790- 4	1.826- 5	5.522- 2
14	2.044-13	1.862-14	3.869-14	1.023-10	1.569- 9	2.146- 9	5.672- 8	1.475- 5	1.140- 6	1.586- 3	1.147- 3
15	1.030-14	4.422-13	4.180-12	5.251-12	2.835-10	9.796-11	3.246- 8	7.055- 7	3.676- 5	6.009- 5	2.680- 3
16	1.480-13	6.323-13	4.337-12	3.725-11	5.631-11	4.646-11	2.236- 9	1.542- 7	5.012- 5	5.658- 5	4.264- 4
17	2.658-13	3.321-13	2.178-12	2.988-11	2.424-10	2.531-11	1.343-10	8.362- 5	3.095- 7	2.492- 5	7.018- 5
18	7.414-14	3.720-14	5.689-13	1.183-11	1.633-10	1.030- 9	5.853-10	4.153- 9	6.778- 7	4.750- 8	9.133- 5
19	1.348-14	1.891-14	2.405-14	1.912-12	4.437-11	5.322-10	2.424- 9	4.145-10	1.072- 7	2.920- 6	2.864- 6
20	1.280-13	8.206-14	5.241-14	2.545-14	1.626-12	1.214-10	1.744- 9	2.148- 9	8.521-10	1.079- 6	6.645- 6

Table 86 (cont'd)

(N2 PHOTO 3)

V	VV 11	12	13	14	15	16	17	18	19	20
0	1.024- 8	3.835- 9	1.526- 9	5.885-10	2.210-10	9.191-11	3.261-11	1.553-11	8.857-12	5.188-12
1	2.912- 7	1.131- 7	4.525- 8	1.852- 8	7.738- 9	3.302- 9	1.437- 9	6.373-10	2.884-10	1.344-10
2	4.066- 6	1.620- 6	6.748- 7	2.895- 7	1.209- 7	5.655- 8	2.559- 8	1.134- 8	5.552- 9	2.659- 9
3	3.792- 5	1.525- 5	6.534- 6	2.908- 6	1.329- 6	5.192- 7	2.932- 7	1.410- 7	6.885- 8	3.421- 8
4	2.664- 4	1.073- 4	4.653- 5	2.127- 5	1.007- 5	4.895- 6	2.412- 6	1.209- 6	6.145- 7	3.169- 7
5	1.487- 3	5.985- 4	2.613- 4	1.215- 4	5.910- 5	2.972- 5	1.526- 5	7.952- 6	4.211- 6	2.256- 6
6	6.637- 3	2.729- 3	1.201- 3	5.652- 4	2.815- 4	1.455- 4	7.737- 5	4.193- 5	2.306- 5	1.284- 5
7	2.343- 2	1.000- 2	4.582- 3	2.196- 3	1.114- 3	5.935- 4	3.236- 4	1.816- 4	1.037- 4	5.995- 5
8	5.837- 2	2.382- 2	1.417- 2	7.129- 3	3.703- 3	2.016- 3	1.137- 3	6.593- 4	3.899- 4	2.339- 4
9	1.126- 1	5.767- 2	3.589- 2	1.864- 2	1.035- 2	5.831- 3	3.386- 3	2.027- 3	1.241- 3	7.723- 4
10	2.388- 2	1.078- 1	5.459- 2	4.106- 2	2.292- 2	1.439- 2	8.477- 3	5.238- 3	3.361- 3	2.171- 3
11	1.079- 1	5.144- 3	1.025- 1	4.676- 2	4.497- 2	2.520- 2	1.802- 2	1.135- 2	7.739- 3	5.190- 3
12	5.732- 1	1.068- 1	3.826- 4	9.812- 2	3.459- 2	4.715- 2	2.754- 2	2.157- 2	1.462- 2	1.054- 2
13	6.562- 3	5.297- 1	1.052- 1	1.374- 2	9.617- 2	1.980- 2	4.823- 2	2.594- 2	2.453- 2	1.702- 2
14	7.547- 2	2.789- 2	4.510- 1	9.855- 2	4.693- 2	9.759- 2	5.144- 3	4.893- 2	2.075- 2	2.625- 2
15	6.441- 3	9.136- 2	6.858- 2	3.388- 1	8.174- 2	9.554- 2	1.023- 1	3.833- 6	5.064- 2	1.237- 2
16	3.538- 3	2.113- 2	9.406- 2	1.265- 1	2.082- 1	5.251- 2	1.455- 1	1.078- 1	9.704- 3	5.517- 2
17	1.754- 3	3.035- 3	5.145- 2	7.591- 2	1.840- 1	9.914- 2	1.803- 2	1.716- 1	1.074- 1	4.153- 2
18	9.952- 6	5.152- 3	8.835- 4	9.870- 2	3.951- 2	2.102- 1	1.533- 2	2.021- 8	1.500- 1	9.069- 2
19	2.394- 4	1.779- 4	1.118- 2	9.053- 4	1.434- 1	5.932- 3	1.715- 1	5.955- 4	2.500- 2	8.253- 2
20	4.925- 5	3.814- 4	2.325- 3	1.678- 2	1.736- 2	1.648- 1	4.511- 3	7.925- 2	1.078- 2	8.831- 2

Table 87 RKR FRANCK-CONDON FACTOR FOR (N2 PHOTO 6)

V'V	0	1	2	3	4	5	6	7	8	9	10
0	2.797- 3	2.213- 2	7.911- 2	1.883- 1	2.365- 1	2.297- 1	1.557- 1	7.479- 2	2.426- 2	5.031- 3	7.954- 4
1	1.413- 2	7.391- 2	1.504- 1	1.352- 1	3.248- 2	1.024- 2	1.189- 1	2.023- 1	1.639- 1	7.561- 2	2.017- 2
2	3.731- 2	1.222- 1	1.171- 1	1.491- 2	3.177- 2	1.077- 1	4.482- 2	7.014- 3	1.251- 1	2.018- 1	1.364- 1
3	6.852- 2	1.293- 1	3.508- 2	1.772- 2	8.762- 2	1.957- 2	2.791- 2	9.458- 2	1.918- 2	3.650- 2	1.798- 1
4	9.854- 2	9.339- 2	1.955- 7	6.936- 2	3.161- 2	1.749- 2	7.262- 2	3.358- 3	5.609- 2	6.911- 2	4.720- 4
5	1.185- 1	4.331- 2	2.397- 2	6.257- 2	8.055- 4	6.306- 2	8.750- 3	4.150- 2	4.349- 2	8.117- 3	8.359- 2
6	1.243- 1	8.603- 3	5.813- 2	1.889- 2	3.440- 2	3.255- 2	1.560- 2	4.845- 2	2.393- 3	6.136- 2	3.615- 3
7	1.172- 1	3.600- 4	6.547- 2	3.350- 5	5.456- 2	2.955- 4	4.978- 2	2.721- 3	4.559- 2	1.037- 2	3.819- 2
8	1.017- 1	1.182- 2	4.643- 2	1.595- 2	3.360- 2	1.702- 2	2.974- 2	1.600- 2	3.108- 2	1.314- 2	3.752- 2
9	8.254- 2	3.654- 2	2.855- 2	3.398- 2	6.297- 3	4.099- 2	1.730- 3	4.107- 2	4.508- 4	4.166- 2	2.406- 4
10	6.319- 2	4.592- 2	3.765- 3	4.639- 2	9.670- 4	3.636- 2	7.553- 3	2.693- 2	1.502- 2	1.955- 2	2.102- 2

V'V	11	12	13	14	15	16	17	18	19	20
0	2.708- 5	4.217- 8	4.536- 5	1.073-10	7.491-10	2.522-12	1.533-11	2.134-14	4.288-13	4.033-14
1	2.770- 3	1.410- 4	1.533- 7	2.834- 7	2.882-11	5.811- 9	2.370-12	1.354-10	2.223-12	3.594-12
2	4.641- 2	7.568- 3	4.241- 4	3.416- 7	9.156- 7	5.347- 9	2.328- 8	2.697-10	5.676-10	3.697-11
3	1.865- 1	8.189- 2	1.575- 2	9.747- 4	5.979- 7	2.088- 5	4.888- 9	6.379- 8	2.640- 9	1.481- 9
4	1.213- 1	2.139- 1	1.226- 1	2.783- 2	1.914- 3	1.637- 5	3.731- 6	2.230- 7	1.343- 7	1.293- 8
5	1.436- 2	6.385- 2	2.154- 1	1.640- 1	4.414- 2	3.405- 3	4.339- 6	5.470- 6	7.102- 7	2.319- 7
6	5.836- 2	4.751- 2	1.905- 2	1.945- 1	2.022- 1	5.496- 2	5.581- 3	1.274- 5	6.623- 6	1.820- 6
7	2.933- 2	2.258- 2	7.283- 2	5.491- 4	1.578- 1	2.334- 1	9.011- 2	9.897- 3	3.757- 5	6.157- 6
8	8.232- 3	5.112- 2	1.782- 3	7.737- 2	6.005- 3	1.129- 1	2.544- 1	1.139- 1	1.416- 2	1.104- 4
9	4.431- 2	6.670- 4	5.041- 2	3.770- 3	5.224- 2	2.642- 2	6.796- 2	2.624- 1	1.543- 1	2.285- 2
10	1.561- 2	2.596- 2	1.536- 2	3.875- 2	2.121- 2	3.518- 2	5.185- 2	2.918- 2	2.529- 1	1.952- 1

Table 88 RKR FRANCK-CONDON FACTORS FOR (3)(2) PHOTO 1)

VV V	0	1	2	3	4	5	6	7	8	9	10	11
0	2.297- 1	2.953- 1	2.227- 1	1.311- 1	6.695- 2	3.113- 2	1.368- 2	5.631- 3	2.317- 3	9.226- 4	3.624- 4	1.422- 4
1	3.899- 1	4.771- 2	2.491- 2	1.188- 1	1.468- 1	1.158- 1	7.426- 2	4.128- 2	2.109- 2	1.015- 2	4.679- 3	2.096- 3
2	2.666- 1	9.472- 2	1.539- 1	2.223- 2	1.398- 2	7.533- 2	1.365- 1	9.591- 2	6.859- 2	4.256- 2	2.480- 2	1.270- 2
3	9.398- 2	2.967- 1	5.690- 5	1.184- 1	9.886- 2	7.041- 3	1.459- 2	5.012- 2	9.459- 2	7.993- 2	6.070- 2	4.031- 2
4	1.800- 2	2.088- 1	1.914- 1	4.962- 2	3.537- 2	1.836- 1	4.667- 2	8.544- 4	1.739- 2	5.259- 2	7.801- 2	6.257- 2
5	1.774- 3	5.637- 2	2.674- 1	7.690- 2	1.094- 1	4.012- 4	6.813- 2	7.474- 2	2.112- 2	2.262- 4	2.446- 2	4.776- 2
6	7.537- 5	7.384- 3	1.104- 1	2.745- 1	1.275- 2	1.251- 1	1.435- 2	2.520- 2	7.217- 2	4.582- 2	7.308- 3	2.452- 3
7	1.053- 6	3.811- 4	1.822- 2	1.676- 1	2.468- 1	9.998- 4	1.015- 1	4.572- 2	2.162- 3	4.868- 2	5.918- 2	2.558- 2
8	2.182- 9	4.649- 5	1.097- 3	3.441- 2	2.187- 1	1.937- 1	2.161- 2	5.230- 2	7.153- 2	3.065- 3	2.195- 2	5.435- 2
9	6.526- 9	1.413- 3	1.153- 5	2.322- 3	5.514- 2	2.593- 1	1.359- 1	5.334- 2	2.717- 2	7.855- 2	1.857- 2	4.319- 3
10	8.433-11	2.705- 6	1.652- 7	2.039- 5	4.095- 3	7.945- 2	2.873- 1	8.490- 2	8.125- 2	6.876- 3	6.929- 2	3.730- 2
11	5.774-10	1.971- 5	4.257- 6	8.590- 7	2.927- 5	6.397- 3	1.061- 1	3.032- 1	4.598- 2	9.792- 2	9.776- 6	5.119- 2
12	3.307-10	6.721- 5	2.933-11	3.857- 8	2.565- 6	3.356- 5	9.128- 3	1.339- 1	3.091- 1	2.062- 2	1.022- 1	5.387- 3
13	6.271-11	3.266-10	1.032- 8	2.636- 9	3.908- 8	6.226- 6	2.848- 5	1.201- 2	1.608- 1	3.084- 1	6.525- 3	9.694- 2
14	3.529-11	4.698-10	1.504- 9	5.315- 9	1.195- 8	4.734- 8	1.418- 5	1.124- 5	1.457- 2	1.868- 1	3.047- 1	7.453- 4

Table 88 (cont'd)

V\V	12	13	14	15	16	17	18	19	20	21	22	23
0	5.595- 5	2.219- 5	9.308- 6	3.532- 6	1.377- 6	5.139- 7	1.856- 7	5.515- 8	2.424- 8	1.113- 8	7.119- 9	5.698- 9
1	9.166- 4	3.938- 4	1.677- 4	7.122- 5	3.030- 5	1.239- 5	5.023- 6	2.457- 6	1.104- 6	5.122- 7	2.517- 7	1.332- 7
2	6.397- 3	3.106- 3	1.471- 3	6.852- 4	3.151- 4	1.458- 4	6.774- 5	3.191- 5	1.531- 5	7.527- 6	3.785- 6	1.930- 6
3	2.438- 2	1.378- 2	7.437- 3	3.879- 3	1.975- 3	9.925- 4	4.959- 4	2.498- 4	1.249- 4	6.376- 5	3.294- 5	1.705- 5
4	5.320- 2	3.689- 2	2.349- 2	1.406- 2	8.056- 3	4.488- 3	2.442- 3	1.315- 3	7.038- 4	3.771- 4	2.021- 4	1.073- 4
5	6.069- 2	5.781- 2	4.645- 2	3.338- 2	2.218- 2	1.336- 2	8.454- 3	4.998- 3	2.877- 3	1.643- 3	9.279- 4	5.130- 4
6	2.290- 2	4.353- 2	5.270- 2	4.990- 2	4.075- 2	3.017- 2	2.185- 2	1.373- 2	9.714- 3	5.393- 3	3.259- 3	1.916- 3
7	1.422- 3	5.026- 3	2.418- 2	4.004- 2	4.606- 2	4.333- 2	3.608- 2	2.739- 2	1.958- 2	1.340- 2	8.823- 3	5.541- 3
8	4.144- 2	1.199- 2	3.336- 7	8.500- 3	2.434- 2	3.625- 2	4.038- 2	3.798- 2	3.197- 2	2.494- 2	1.829- 2	1.257- 2
9	3.846- 2	4.747- 2	2.581- 2	4.378- 3	7.057- 4	1.051- 2	2.353- 2	3.254- 2	3.542- 2	3.339- 2	2.658- 2	2.134- 2
10	1.187- 4	2.016- 2	4.236- 2	3.596- 2	1.464- 2	1.223- 3	2.034- 3	1.153- 2	2.205- 2	2.897- 2	3.094- 2	2.829- 2
11	5.057- 2	6.191- 3	5.412- 3	3.148- 2	3.899- 2	2.432- 2	7.688- 3	1.212- 4	3.213- 3	1.172- 2	2.009- 2	2.451- 2
12	3.136- 2	5.447- 2	1.751- 2	3.192- 4	1.816- 2	3.474- 2	3.147- 2	1.648- 2	3.880- 3	3.154- 5	3.927- 3	1.071- 2
13	1.692- 2	1.496- 2	5.402- 2	2.887- 2	1.549- 3	7.307- 3	2.604- 2	3.252- 2	2.411- 2	1.073- 2	1.776- 3	2.330- 4
14	8.504- 2	3.015- 2	4.550- 3	4.123- 2	3.632- 2	7.696- 3	1.202- 3	1.535- 2	2.892- 2	2.833- 2	1.801- 2	6.859- 3

Table 89

RKR FRANCK-CONDON FACTORS FOR (3)(2) P4(3) 2)

V V	0	1	2	3	4	5	6	7	8	9	10	11
0	9.841- 3	5.379- 2	1.372- 1	2.139- 1	2.286- 1	1.789- 1	1.059- 1	4.837- 2	1.724- 2	4.986- 3	1.121- 3	2.054- 4
1	3.586- 2	1.226- 1	1.575- 1	7.425- 2	7.369- 4	5.857- 2	1.493- 1	1.794- 1	1.303- 1	6.637- 2	2.548- 2	7.159- 3
2	7.159- 2	1.406- 1	5.138- 2	1.966- 3	8.123- 2	9.004- 2	1.478- 2	2.111- 2	1.183- 1	1.567- 1	1.242- 1	6.538- 2
3	1.040- 1	1.023- 1	1.517- 3	6.166- 2	7.093- 2	4.483- 4	5.897- 2	8.917- 2	1.445- 2	2.192- 2	1.193- 1	1.617- 1
4	1.234- 1	4.672- 2	1.872- 2	7.731- 2	3.973- 3	4.885- 2	5.324- 2	7.683- 8	6.313- 2	7.641- 2	5.298- 3	3.923- 2
5	1.272- 1	9.153- 3	5.664- 2	3.237- 2	1.881- 2	6.155- 2	3.328- 4	5.626- 2	4.189- 2	4.117- 3	7.623- 2	5.474- 2
6	1.182- 1	3.220- 4	6.850- 2	1.131- 3	5.484- 2	1.324- 2	3.282- 2	4.381- 2	3.797- 3	6.484- 2	1.775- 2	2.254- 2
7	1.016- 1	1.237- 2	5.120- 2	9.840- 3	4.778- 2	3.158- 3	5.247- 2	4.128- 4	5.888- 2	1.760- 2	2.341- 2	5.944- 2
8	8.226- 2	3.205- 2	2.434- 2	3.460- 2	1.671- 2	3.891- 2	2.872- 2	2.242- 2	3.376- 2	8.263- 3	5.148- 2	3.739- 4
9	6.357- 2	4.922- 2	5.289- 3	4.821- 2	2.240- 4	4.469- 2	2.388- 5	4.334- 2	7.787- 4	4.333- 2	7.014- 3	3.475- 2
10	4.726- 2	5.898- 2	6.888- 5	4.316- 2	7.522- 3	3.833- 2	1.339- 2	2.575- 2	1.444- 2	2.869- 2	1.825- 2	3.791- 2

V V	12	13	14	15	16	17	18	19	20	21	22	23
0	2.909- 5	2.815- 6	1.937- 7	3.215- 8	7.382- 9	9.432-10	1.757- 9	1.378- 9	5.489-10	1.529- 9	7.883-13	9.591-13
1	1.563- 3	2.571- 4	3.139- 5	3.459- 6	3.256- 7	2.915- 9	1.822- 9	2.856- 9	1.339- 9	2.388- 9	1.781-10	1.880- 9
2	2.378- 2	5.347- 3	1.208- 3	1.857- 4	2.845- 5	1.635- 6	7.655- 8	4.280- 9	1.356- 9	3.722-10	5.214-10	9.373-10
3	1.165- 1	5.492- 2	1.881- 2	4.228- 3	7.204- 4	9.858- 5	8.404- 6	4.641- 7	1.854- 8	1.408- 9	3.247-10	1.029-10
4	1.350- 1	1.532- 1	3.660- 2	3.944- 2	1.112- 2	2.214- 3	3.135- 4	3.834- 5	1.909- 6	9.752- 8	2.576- 8	5.465- 9
5	8.553- 5	7.802- 2	1.524- 1	1.363- 1	7.109- 2	2.418- 2	5.591- 3	8.931- 4	9.991- 5	8.241- 6	7.942- 7	1.728- 7
6	9.310- 2	2.493- 2	1.351- 2	1.121- 1	1.576- 1	1.882- 1	4.487- 2	1.215- 2	2.243- 3	2.988- 4	3.374- 5	4.650- 6
7	7.211- 4	5.420- 2	6.841- 2	1.864- 3	5.392- 2	1.498- 1	1.413- 1	7.296- 2	2.348- 2	5.121- 3	8.491- 4	1.298- 4
8	5.091- 2	3.084- 2	1.832- 2	7.878- 2	3.188- 2	9.985- 3	1.118- 1	1.538- 1	1.849- 1	4.101- 2	1.896- 2	2.334- 3
9	2.771- 2	1.215- 2	5.888- 2	2.787- 3	4.789- 2	6.851- 2	1.577- 3	5.896- 2	1.526- 1	1.342- 1	6.632- 2	2.242- 2
10	2.636- 3	4.907- 2	1.836- 3	4.515- 2	3.152- 2	1.818- 2	7.839- 2	2.694- 2	1.598- 2	1.179- 1	1.542- 1	1.024- 1

Table 90 RKR FRANCK-CONDON FACTORS FOR CO(2) PHOTO 3)

V'V	0	1	2	3	4	5	6	7	8	9	10	11
0	2.955- 3	1.975- 2	5.361- 2	1.290- 1	1.851- 1	2.037- 1	1.705- 1	1.154- 1	6.472- 2	3.803- 2	1.161- 2	3.919- 3
1	1.303- 2	5.123- 2	1.243- 1	1.307- 1	6.245- 2	3.826- 3	2.441- 2	9.976- 2	1.508- 1	1.433- 1	9.942- 2	5.327- 2
2	3.137- 2	9.941- 2	1.119- 1	3.594- 2	2.525- 3	6.251- 2	9.192- 2	3.710- 2	1.632- 4	4.633- 2	1.182- 1	1.416- 1
3	5.474- 2	1.135- 1	5.250- 2	5.501- 4	5.664- 2	6.598- 2	6.142- 3	2.427- 2	8.805- 2	5.427- 2	2.503- 3	2.651- 2
4	7.762- 2	9.156- 2	7.387- 3	3.253- 2	0.314- 2	5.819- 3	2.767- 2	5.491- 2	1.495- 2	1.212- 2	6.901- 2	5.794- 2
5	9.507- 2	5.691- 2	2.617- 3	5.912- 2	2.011- 2	1.328- 2	5.625- 2	1.848- 2	1.889- 2	5.987- 2	1.672- 2	9.655- 3
6	1.044- 1	2.417- 2	2.396- 2	4.824- 2	4.043- 5	4.522- 2	2.878- 2	1.316- 2	5.889- 2	9.557- 3	1.849- 2	5.613- 2
7	1.052- 1	4.439- 3	4.531- 2	1.966- 2	1.662- 2	3.359- 2	1.353- 4	4.141- 2	1.682- 2	1.216- 2	4.680- 2	5.651- 3
8	9.910- 2	2.716- 4	5.131- 2	1.526- 3	3.708- 2	1.222- 2	1.884- 2	3.133- 2	1.519- 3	4.049- 2	9.206- 3	1.790- 2
9	6.418- 2	7.758- 3	4.249- 2	3.181- 3	3.831- 2	3.896- 6	3.545- 2	4.851- 3	2.469- 2	2.187- 2	5.796- 3	3.458- 2
10	7.469- 2	2.954- 2	2.646- 2	1.667- 2	2.278- 2	9.557- 3	2.737- 2	2.538- 3	3.292- 2	4.126- 4	3.015- 2	1.154- 2

V'V	12	13	14	15	16	17	18	19	20	21	22	23
0	1.092- 3	2.549- 4	5.095- 5	9.481- 6	1.509- 6	1.243- 7	4.724- 9	7.896- 9	2.887- 9	2.598- 9	2.578-11	2.045- 9
1	2.285- 2	8.827- 3	2.332- 3	5.673- 4	1.158- 4	1.919- 5	2.628- 6	3.612- 7	4.279- 8	2.618-10	1.831-14	2.490- 9
2	1.118- 1	6.539- 2	2.934- 2	1.052- 2	3.074- 3	7.421- 4	1.473- 4	2.357- 5	3.137- 6	3.932- 7	5.429- 9	1.232- 9
3	3.919- 2	1.304- 1	1.148- 1	6.862- 2	3.128- 2	1.116- 2	3.195- 3	7.362- 4	1.384- 4	2.295- 5	3.909- 6	7.153- 7
4	4.796- 3	2.116- 2	9.233- 2	1.328- 1	1.128- 1	6.592- 2	2.967- 2	1.021- 2	2.887- 3	6.413- 4	1.347- 4	2.883- 5
5	6.552- 2	5.524- 2	3.942- 3	2.313- 2	9.532- 2	1.316- 1	1.075- 1	5.888- 2	2.580- 2	8.634- 3	2.404- 3	6.243- 4
6	1.346- 2	1.229- 2	5.588- 2	4.866- 2	1.509- 3	3.872- 2	1.028- 1	1.231- 1	9.803- 2	5.264- 2	2.229- 2	8.151- 3
7	2.298- 2	5.233- 2	7.789- 3	1.873- 2	6.759- 2	3.878- 2	8.842- 7	4.256- 2	1.895- 1	1.228- 1	8.851- 2	4.992- 2
8	4.191- 2	1.565- 3	3.855- 2	4.629- 2	2.294- 3	2.921- 2	6.834- 2	2.679- 2	1.789- 3	5.458- 2	1.148- 1	1.251- 1
9	3.842- 3	2.579- 2	3.429- 2	4.382- 5	3.944- 2	3.654- 2	1.865- 5	4.241- 2	6.414- 2	1.542- 2	7.407- 3	7.727- 2
10	1.338- 2	3.323- 2	2.796- 5	3.402- 2	2.352- 2	3.535- 3	4.675- 2	2.433- 2	3.211- 3	5.232- 2	5.365- 2	4.391- 3

Table 91

RKR FRANCK-CONDON FACTORS FOR (3(2) PHOTO 4)

V	VV 0	1	2	3	4	5	6	7	8	9	10	11
0	4.120- 1	3.731- 1	1.612- 1	4.376- 2	8.425- 3	1.246- 3	1.568- 4	1.436- 5	9.138- 7	6.088- 8	9.984- 9	5.966-10
1	3.373- 1	2.865- 3	2.316- 1	2.605- 1	1.233- 1	3.556- 2	7.304- 3	1.126- 3	1.335- 4	1.219- 5	1.162- 6	1.179- 7
2	1.620- 1	1.714- 1	8.146- 2	4.738- 2	2.284- 1	1.950- 1	8.476- 2	2.344- 2	4.644- 3	7.857- 4	8.514- 5	9.388- 6
3	6.059- 2	2.117- 1	1.790- 2	1.611- 1	2.802- 3	1.157- 1	2.158- 1	1.426- 1	5.383- 2	1.387- 2	2.687- 3	3.991- 4
4	1.973- 2	1.3e4- 1	1.324- 1	1.509- 2	1.186- 1	6.439- 2	2.149- 2	1.686- 1	1.838- 1	9.734- 2	3.284- 2	7.999- 3
5	5.938- 3	6.476- 2	1.587- 1	3.308- 2	8.252- 2	3.233- 2	1.208- 1	3.292- 3	8.342- 2	1.846- 1	1.432- 1	6.333- 2
6	1.708- 3	2.606- 2	1.117- 1	1.141- 1	4.962- 4	1.039- 1	4.189- 4	1.053- 1	4.974- 2	1.496- 2	1.383- 1	1.712- 1
7	4.770- 4	9.442- 3	6.002- 2	1.285- 1	4.241- 2	3.629- 2	5.927- 2	3.573- 2	4.392- 2	9.795- 2	3.6e4- 3	6.579- 2
8	1.294- 4	3.162- 3	2.739- 2	9.443- 2	1.004- 1	1.467- 3	7.8e7- 2	1.392- 2	8.193- 2	1.505- 3	9.5e4- 2	4.151- 2
9	3.332- 5	1.011- 3	1.120- 2	5.479- 2	1.083- 1	4.559- 2	1.453- 2	7.541- 2	2.835- 3	7.830- 2	1.631- 2	4.742- 2
10	7.705- 6	3.022- 4	4.237- 3	2.732- 2	8.208- 2	8.797- 2	5.820- 3	5.230- 2	3.283- 2	3.767- 2	3.288- 2	5.894- 2

III

V	VV 12	13	14	15	16	17	18	19	20	21	22	23
0	1.726-10	2.077-12	3.963-11	6.648-11	1.825-11	2.554-11	9.725-11	1.796-11	2.419-11	6.013-11	9.e83-12	7.437-12
1	3.482- 9	2.620-10	1.032-10	2.521-10	1.263-10	9.332-11	5.221-11	4.07e-11	7.143-11	1.146-10	9.734-12	1.930-10
2	8.076- 7	9.387- 9	1.139-10	3.936- 9	1.812- 9	1.122- 9	8.304-10	1.111- 9	1.185-10	9.493-10	3.e38-11	2.841-10
3	4.717- 5	3.934- 8	1.765- 7	4.388- 8	1.631- 8	3.833- 9	2.588- 9	2.557- 9	6.609-10	1.918- 9	3.e34-11	1.440- 9
4	1.403- 3	1.938- 6	2.121- 5	1.893- 6	1.987- 7	6.810- 9	2.349- 9	1.312- 9	2.492- 9	2.889- 9	3.127-10	1.453- 9
5	1.902- 2	4.168- 5	6.976- 4	9.130- 5	9.825- 6	8.837- 7	5.461- 8	1.129- 9	9.184-10	5.998-11	1.2e8- 9	7.753-10
6	1.027- 1	3.937- 2	1.057- 2	2.187- 3	3.240- 4	3.894- 5	4.e90- 6	2.898- 7	7.683- 9	1.477- 9	1.725- 9	1.e10-11
7	1.644- 1	1.411- 1	6.991- 2	2.316- 2	5.586- 3	1.827- 3	1.648- 4	1.6e9- 5	1.318- 6	1.103- 7	3.442- 8	1.205- 9
8	1.123- 2	1.193- 1	1.e14- 1	1.068- 1	4.464- 2	1.389- 2	2.851- 3	4.695- 4	6.322- 5	7.338- 6	1.172- 6	3.110- 7
9	8.461- 2	3.323- 3	5.530- 2	1.493- 1	1.403- 1	7.543- 2	2.712- 2	7.893- 3	1.41e- 3	2.422- 4	4.1e5- 5	8.924- 6
10	4.514- 3	8.621- 2	3.937- 2	7.800- 3	1.035- 1	1.546- 1	1.112- 1	5.028- 2	1.623- 2	4.874- 3	9.277- 4	2.192- 4

Table 92

RKR FRANCK-CONDON FACTORS FOR (3)(2) PHOTO 51

V'V	0	1	2	3	4	5	6	7	8	9	10	11
0	6.750- 2	1.538- 1	2.110- 1	2.079- 1	1.639- 1	1.024- 1	5.513- 2	2.552- 2	1.033- 2	3.728- 3	1.243- 3	3.499- 4
1	1.843- 1	1.691- 1	5.857- 2	1.542- 5	4.226- 2	1.136- 1	1.002- 1	1.251- 1	8.336- 2	4.566- 2	2.129- 2	4.443- 3
2	2.538- 1	4.170- 2	1.208- 2	9.076- 2	8.891- 2	1.570- 2	5.675- 3	5.200- 2	1.149- 1	1.225- 1	9.402- 2	5.725- 2
3	2.299- 1	8.952- 3	9.844- 2	4.860- 2	1.122- 3	5.523- 2	7.845- 2	2.730- 2	4.448- 4	3.914- 2	9.526- 2	1.152- 1
4	1.522- 1	9.858- 2	5.323- 2	2.092- 3	6.689- 2	4.248- 2	2.412- 6	4.140- 2	7.095- 2	3.220- 2	2.300- 5	2.904- 2
5	7.592- 2	1.798- 1	7.360- 5	5.151- 2	3.950- 2	4.174- 3	5.382- 2	3.873- 2	5.534- 7	3.537- 2	6.277- 3	3.155- 2
6	2.777- 2	1.734- 1	5.151- 2	4.249- 2	2.632- 4	5.653- 2	2.144- 2	5.272- 3	5.197- 2	3.150- 2	4.288- 5	3.517- 2
7	6.589- 3	1.140- 1	1.419- 1	8.433- 4	3.896- 2	3.411- 2	7.844- 3	4.555- 2	1.324- 2	9.663- 3	4.815- 2	2.559- 2
8	5.908- 4	4.733- 2	1.630- 1	3.531- 2	2.958- 2	3.762- 5	5.118- 2	1.059- 2	1.155- 2	4.520- 2	6.855- 3	1.373- 2
9	5.144- 5	1.222- 2	1.229- 1	1.188- 1	7.755- 4	1.753- 2	3.203- 2	1.877- 2	3.534- 2	5.869- 3	2.102- 2	3.626- 2
10	3.981- 4	9.251- 4	5.933- 2	1.577- 1	2.699- 2	1.948- 2	8.511- 4	4.750- 2	5.891- 3	1.391- 2	3.548- 2	1.531- 4

V'V	12	13	14	15	16	17	18	19	20	21	22	23
0	8.760- 5	1.889- 5	3.744- 6	7.819- 7	1.427- 7	8.258- 9	1.423-10	2.298- 9	3.478-10	9.595-10	1.822-11	4.988-13
1	2.983- 3	8.643- 4	2.251- 4	5.387- 5	1.125- 5	1.745- 6	2.393- 7	5.341- 8	9.783- 9	7.382-10	1.152-12	2.228- 9
2	2.836- 2	1.182- 2	4.136- 3	1.280- 3	3.424- 4	7.819- 5	1.532- 5	2.774- 6	4.429- 7	4.119- 8	5.965- 9	6.137- 9
3	9.728- 2	6.248- 2	3.248- 2	1.362- 2	4.887- 3	1.501- 3	3.938- 4	8.787- 5	1.662- 5	3.823- 6	5.348- 7	1.196- 7
4	1.477- 2	1.114- 1	9.712- 2	5.332- 2	3.287- 2	1.438- 2	4.968- 3	1.476- 3	3.738- 4	8.488- 5	1.862- 5	4.231- 6
5	1.105- 4	2.781- 2	8.119- 2	1.683- 1	9.473- 2	6.157- 2	3.146- 2	1.334- 2	4.496- 3	1.338- 3	3.659- 4	9.451- 5
6	6.148- 2	2.842- 3	3.557- 6	2.899- 2	8.252- 2	1.878- 1	9.695- 2	5.717- 2	2.825- 2	1.147- 2	4.298- 3	1.379- 3
7	6.516- 4	3.748- 2	5.446- 2	2.311- 2	2.996- 4	3.455- 2	8.673- 2	1.838- 1	8.453- 2	5.113- 2	2.545- 2	1.134- 2
8	4.729- 2	1.827- 2	2.466- 3	4.218- 2	5.449- 2	1.658- 2	2.833- 3	4.247- 2	8.988- 2	9.985- 2	7.368- 2	5.075- 2
9	2.587- 3	2.856- 2	4.396- 2	1.161- 2	6.503- 3	4.745- 2	4.937- 2	1.331- 2	5.522- 3	4.936- 2	9.236- 2	1.051- 1
10	2.594- 2	3.006- 2	9.533- 5	2.660- 2	4.815- 2	5.231- 3	1.291- 2	5.252- 2	4.224- 2	4.934- 3	1.006- 2	6.544- 2

Table 93

RKR FRANCK-CONDON FACTORS FOR (O(2) PHOTO 6)

VV	0	1	2	3	4	5	6	7	8	9	10	11
V												
0	8.722- 1	1.212- 1	2.933- 6	4.845- 3	1.554- 3	3.397- 5	5.298- 5	3.993- 5	2.550- 6	1.585- 6	2.341- 6	2.112- 7
1	9.409- 2	5.623- 1	2.246- 1	1.642- 3	1.148- 2	5.818- 3	4.442- 4	5.717- 5	1.456- 4	4.314- 5	7.277- 7	2.773- 5
2	3.234- 2	1.336- 1	4.813- 1	3.106- 1	4.879- 3	2.841- 2	1.446- 2	1.710- 3	6.015- 5	3.971- 4	1.884- 4	2.111- 5
3	9.708- 4	7.724- 2	1.479- 1	3.297- 1	3.691- 1	1.249- 2	2.323- 2	2.816- 2	4.504- 3	4.493- 5	9.874- 4	5.716- 4
4	3.295- 4	3.754- 3	1.329- 1	1.344- 1	2.130- 1	3.923- 1	2.321- 2	3.544- 2	4.324- 2	9.336- 3	1.577- 5	1.757- 3
5	2.337- 6	1.703- 3	7.770- 3	1.933- 1	1.148- 1	1.272- 1	3.897- 1	3.635- 2	4.083- 2	6.761- 2	1.686- 2	1.720- 5
6	7.696- 6	6.504- 7	5.171- 5	1.279- 2	2.447- 1	8.720- 2	5.636- 2	3.621- 1	5.000- 2	4.226- 2	9.014- 2	2.729- 2
7	5.316- 6	6.124- 5	1.542- 5	1.091- 2	1.838- 2	2.918- 1	5.395- 2	2.742- 2	3.172- 1	6.176- 2	4.074- 2	1.117- 1
8	3.715- 6	2.476- 5	2.340- 4	6.517- 5	1.966- 2	2.451- 2	3.254- 1	3.824- 2	6.845- 3	2.615- 1	7.072- 2	3.695- 2
9	1.227- 5	1.814- 5	9.712- 5	6.542- 4	1.594- 4	3.143- 2	3.120- 2	3.478- 1	2.123- 2	9.145- 5	2.056- 1	7.644- 2
10	2.754- 7	9.008- 5	5.329- 5	2.355- 4	1.447- 3	2.951- 4	4.595- 2	3.876- 2	3.590- 1	1.094- 2	2.683- 3	1.417- 1

VV	12	13	14	15	16	17	18	19	20	21	22	23
V												
0	2.491- 7	5.636- 7	1.919- 7	5.710-10	1.014- 7	1.256- 7	4.525- 9	7.730-10	1.170- 9	2.457- 8	1.746- 9	4.924- 9
1	2.175- 6	7.772- 9	3.534- 7	5.167- 7	9.235- 8	4.193- 8	2.374- 7	2.134- 7	5.210- 9	2.530- 9	5.858- 8	8.300- 9
2	9.475- 7	5.949- 6	2.534- 6	9.783- 8	2.007- 7	2.559- 7	2.455- 9	5.257- 8	1.740- 7	1.306- 7	2.192- 9	7.248- 9
3	1.346- 4	8.559- 9	1.341- 5	1.228- 5	3.125- 6	3.480- 8	3.206- 7	3.122- 7	2.976- 9	4.776- 9	1.607- 7	1.134- 7
4	1.348- 3	3.169- 4	5.230- 6	2.291- 5	3.340- 5	1.449- 5	1.974- 5	3.746- 8	5.801- 7	3.635- 7	2.403- 9	4.039- 9
5	2.995- 3	2.770- 3	9.060- 4	3.813- 5	3.354- 5	7.507- 5	4.555- 5	1.170- 5	5.124- 7	5.207- 7	1.099- 6	5.072- 7
6	8.200- 5	4.635- 3	5.132- 3	1.753- 3	1.318- 4	4.403- 5	1.547- 4	1.153- 4	4.022- 5	4.334- 6	1.557- 7	1.491- 5
7	4.410- 2	3.670- 4	5.575- 3	8.533- 3	3.378- 3	3.499- 4	4.905- 5	2.822- 4	2.535- 4	1.386- 4	2.653- 5	1.401- 7
8	1.302- 1	9.407- 2	1.048- 3	8.610- 3	1.318- 2	5.978- 3	7.908- 4	6.475- 5	4.742- 4	5.801- 4	2.496- 4	6.153- 5
9	3.132- 2	1.436- 1	7.036- 2	2.121- 3	1.845- 2	1.631- 2	9.793- 3	1.536- 3	2.830- 5	7.462- 4	9.017- 4	4.975- 4
10	7.698- 2	2.426- 2	1.531- 1	8.482- 2	3.746- 3	1.191- 2	2.525- 2	1.490- 2	2.948- 3	6.265- 6	1.030- 3	1.474- 3

Table 94

TABLE OF FRANCK-CONDON FACTORS BY VARIOUS INVESTIGATORS

Molecule	System	Reference
CN	Red (A-X)	33
CN	Violet (B-X)	33
CO	4(+)(A-X)	33
CO^+	Comet tail (A-X)	34
CO^+	(1-) (B-X)	34
N_2	(1+) (B-A)	33, 35, 36, 37, 29
N_2	(2+) (C-B)	33, 35, 36, 37
N_2	Vegard Kaylan (A-X)	35, 37, 29
N_2	y bands (B'-B)	36
N_2	y bands (a-a')	36
N_2	y bands (w-a)	36
N_2	LBH (a-x)	37
N_2	Tanaka (c-x)	37
N_2	B-H (b', b-x)	33
N_2^+	Meinel (A-X)	33
N_2^+	(1-) (B-X)	33
N_2^+	(2-) (C-X)	33
NO	β (A-X)	33, 38
NO	γ (B-X)	33, 38
NO	δ (C-X)	33
NO	ϵ (D-X)	33
NO	β' (B'-X)	33
NO	γ' (E-X)	33

Table 94 (cont'd)

Molecule	System	Reference
NO	Lagerquist-Miescher (G-X)	33
NO	Heath (C-A)	
NO	Feast 1 (D-A)	33
NO	Feast 2 (E-A)	33
	Feast 2 (E-C)	33
NO	Feast-Heath (E-D)	33
O_2	Schumann-Runge (B-X)	33, 39

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APPENDIX I

COMPUTER PROGRAM TURNGPT

A listing of the computer program used to generate the RK potentials at AFWL is included in this appendix. The input data needed is described and a sample data deck is also included.

1. INPUT DATA

The reduced mass of the molecule or the mass at each atom is needed. These can be based on either C_{12} or O_{16}. A good source for reduced masses based on O_{16} is Herzberg (Ref. 31).

The energy levels of the molecule can be constructed internally in the program if the spectroscopic constants we, wexe, weye, weze, wete are read in. These are used in the equation.

$$E = we(v+\tfrac{1}{2}) - wexe(v+\tfrac{1}{2})^2 + weye(v+\tfrac{1}{2})^3$$

$$+ weze(v+\tfrac{1}{2})^4 + wete(v+\tfrac{1}{2})^5 + \ldots$$

Herzberg (Ref. 31) has a large tabulation of these. Alternatively, one can use the G_v obtained from spectroscopic data. Wallace (Refs. 24, 40) has an extensive tabulation of these.

One also needs the relational constants, that is, either B_e, α_e, δ_e, γ_e, ε_e, or the B_v for the various vibrational levels. Again Herzberg (Ref. 31) is a good source for B_e, α_e, γ_e and Wallace (Refs. 24, 40) is a good source for the B_v. The final bit of data about the molecule that is needed is the equilibrium internuclear separation. This can be found in Herzberg (Ref. 31).

2. DATA DECK

The data deck set-up procedure needs very little explanation since Zare has made extensive use of comment cards throughout his program.

Card Number		
1	ITEST I1	1 if problem follows
2, 3	FMT 8A10	Title of the problem with carriage control in column 1
4	IIMS, ZMAS1, ZMAS2 IF,2E10.0	IIMS = 1 mass based on C = 12 IIMS = 2 mass based on O = 16 ZMAS1 mass of first atom (or reduced mass of molecule) ZMAS2 mass of second atom (or blank when using reduced mass)
5	IQHK, N 2I4, 4x, 6A10	IQHK = 0 using a tabulated Gv curve. Format for Gv in columns 13-72. IQHK ≠ 0 using constants to generate Gv curve. Hollerith text in columns 13-72. N - number of vibrational levels to be used
6a	WE, WEXE, WEYE, WEZE, WETE, 5E10.0	Use when IQHK ≠ 0. These are the spectroscopic constants that generate the energies of the vibrational levels.
6b	G(I) Format in columns 13-72 of Card 5	Use when IQHK = 0. These are the Gv of spectroscopy.
7	IOPEV I1	IOPEV = 0 if zero point energy to be found by extrapolation IOPEV = 1 tabulated Gv curve to be used unchanged IOPEV = 2 if Gv curve is to be constructed from constants
8	IBHK, N 2I4, 4x	IBHK = 0 using tabulated Bv curve. Format for Bv in columns 13-72.

Card Number		
Card 8 (cont'd)		IBHK ≠ 0 constants are used to generate Bv curve. Hollerith text in columns 13-72. N - number at vibrational levels (same as above)
9a	BE, ALPHAE, GAMMAE, DELTAE, 5E10.0	Use when IBHK ≠ 0; these were used to generate the Bv
9b	B(v) Format in columns 13-72 of Card 8	Use when IBHK = 0
10	IOPA, BEQUIL I4, 3F10.0	IOPA = 0 value of BE to be found by extrapolation from Bv data read in IOPA = 1 value of BE given by BEQUIL IOPA = 2 rotational constants are used (leave BEQUIL blank) BEQUIL - spectroscopic constant Be
11	RE F10.0	Internuclear equilibrium distance
12	VSTART, VFIN, HDED 3E10.0	Turning points are calculated from vibrational level VSTART to VFIN to steps of HDED
13	IOPFG I1	IOPFG = 0 intermediate printout skipped IOPFG = 1 intermediate steps in an evaluation of the Klein integrals are to be printed out
14	Blank	

```
      PROGRAM TURNCRT(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,FILMPL,PUNCH   A   1
     1,TAPE7=PUNCH)                                                        A   2
C       SET-UP FOR PLOTTING POTENTIALS...                                  A   3
      CALL INIT2PC                                                         A   4
C     MAIN FINDS TURNING POINTS FOR A MOLECULE BY RYDBERG-KLEIN-REES METH   A   6
C     ALL INPUT IS IN WAVE NUMBERS AND ANGSTROMS.                          A   7
C     USER SPECIFIES CHOICE BETWEEN MASS UNITS BASED ON C12 = 12. OR       A   8
C     O16 = 16.                                                            A   9
C     THE FOLLOWING COMMENT CARDS DESCRIBE THE PREPARATION OF DATA CARDS   A  10
C                                                                          A  11
      DIMENSION VSTART(1), VFIN(1), HDED(1)                                A   5
      DIMENSION XI(200), YI(200), XO(3000), V(3000), S(3000), PV(200), F   A  12
     1TRIAL(200), GI2A(2), GIFN(3), GIMS(2), ZIMS(2), ZIBA(2), ZIFN(3),    A  13
     2FCALC(200), XPRN(5), VPRN(5), DTERMT(6), G(200), PV(200), FMT(16),   A  14
     3 U(200), RMIN(200), RMAX(200), DUFM1(6), RVE(200), GI(200), RVI(20   A  15
     40), J(20), DV(30), RVE(30), DVE1(30), RVE2(30), A(30), Y(30), XX(6   A  16
     5), YY(6), ANS(3), XNN(6), XFL(1), XFE(1), FL(1), D3(2), GB(30), YY   A  17
     6Y(6), SIGH(1)                                                       A  18
      COMMON YI,YI,XO,V,XH,NSTA,N,MSTA,M,XMIN,XMAX,INSC,MREG,NUSED,S,NI,   A  19
     1NS,MAXIT,FACM,ZMU,DE,WE,WEXE,WEYE,WEZE,WETE,BE,ALPHAE,GAMMAE,DELTA   A  20
     2E,AS,BS,MO,STEP,U,RV,G,ICK,H,ITR,HDES,ERSLNE,XX,REQUIL,ZPTEN,MLV,L   A  21
     3V,RE,VSTART,VFIN,HDED                                               A  22
      REAL J1,J2,J3,J4,JHAF2                                               A  23
C                                                                          A  24
C       FIRST CARD IN DATA HAS A ONE IN COLUMN 1 IF A PROBLEM FOLLOWS.     A  25
C       VERY LAST CARD IN DATA MUST BE A BLANK CARD.....                   A  26
C                                                                          A  27
1     CONTINUE                                                             A  28
      READ (5,50) ITEST                                                    A  29
      IF (ITEST) 2,40,2                                                    A  30
C                                                                          A  31
C       NEXT TWO CARDS IN DATA HAVE NAME OF PROBLEM IN COLUMNS 1-80.       A  32
C       WHERE CARRIAGE CONTROL IS IN COLUMN 1.  NEXT CARD HAS IIMS AND     A  33
C       MASSES OF THE TWO ATOMS, OR IIMS AND REDUCED MASS IN FIRST MASS    A  34
C       FIELD WITH SECOND BLANK.                                           A  35
C       IIMS = 1, MASS UNITS ARE BASED ON C12 = 12.                        A  36
C       IIMS = 2, MASS UNITS ARE BASED ON O16 = 16.                        A  37
C                                                                          A  38
2     READ (5,51) (FMT(I),I=1,16)                                          A  39
      READ (5,52) IIMS,ZMAS1,ZMAS2                                         A  40
C                                                                          A  41
C       NEXT CARD IN DATA HAS IQWK, AND NUMBER OF LEVELS, EACH             A  42
C       IN I4 FORMAT, AS WELL AS THE FORMAT STATEMENT WHICH CONTROLS THE   A  43
C       READING OF THE LEVELS (IN COLUMNS 13-72)--FOR EXAMPLE- (4F16.8).   A  44
C       IQWK = 0 IF THE FOLLOWING CARDS CONTAIN THE TABULATED G CURVE.     A  45
C       IF A PARTICULAR VALUE IS TO BE INTERPOLATED, SET G(I) = -10.       A  46
C       IF IT IS DESIRED TO USE CONSTANTS  TO GENERATE THE ENTIRE          A  47
C       G CURVE, IQWK MUST NOT BE EQUAL TO ZERO.                           A  48
C       HOLLERITH TEXT MUST BE PUNCHED IN COLUMNS 13-72,                   A  49
C       AS IT WILL BE PRINTED, E.G.,   (1H )                               A  50
C       THE NEXT CARD IN SUCH A CASE CONTAINS                              A  51
C       WE,WEXE,WEYE,WEZE,AND WETE.                                        A  52
C                                                                          A  53
      READ (5,53) IQWK,N,(DTERMT(I),I=1,6)                                 A  54
      IIFN=2                                                               A  55
```

```
      IF (IQHK) 3,4,3                                                    A  54
3     READ (5,54) WF,WEXF,WEYF,WEZF,WETF                                 A  55
      GO TO 5                                                            A  56
4     READ (5,DTERMT) (GI(I),I=1,N)                                      A  57
C                                                                        A  58
C     THE ZERO POINT ENERGY MAY BE FOUND BY EXTRAPOLATION, OR IT MAY BE  A  59
C     FIXED BY THE USER FROM HIS TABULATED G(V) CURVE.                   A  60
C     NEXT CARD CONTAINS IOPEV.                                          A  61
C     SET IOPEV = 0, IF THE ZERO POINT ENERGY IS TO BE FOUND BY          A  62
C     EXTRAPOLATION, AND THE G(V) CURVE IS TO BE RAISED OR LOWERED       A  63
C     ACCORDINGLY.                                                       A  64
C     THIS IS PARTICULARLY USEFUL IF DELTA G(V) DATA IS TO BE USED.      A  65
C     SET IOPEV = 1, IF THE TABULATED G(V) CURVE IS TO BE USED UNCHANGED A  66
C     SET IOPEV = 2, IF THE G(V) CURVE IS TO BE CONSTRUCTED FROM CONSTAN A  67
C                                                                        A  68
5     READ (5,50) IOPEV                                                  A  69
C                                                                        A  70
C      THE NEXT SET OF CARDS CONTAINS THE BV CURVE WITH THE SAME         A  71
C      RESTRICTIONS AS FOR G CURVE ABOVE.  NUMBER OF VALUES HERE MUST BE A  72
C      EQUAL TO THE NUMBER ABOVE                                         A  73
C                                                                        A  74
      READ (5,53) IBHK,N,(DUMMT(I),I=1,6)                                A  75
      IIEB=2                                                             A  76
      IF (IBHK) 6,7,6                                                    A  77
6     READ (5,54) BE,ALPHAE,GAMMAE,DELTAE,EPSLNE                         A  78
      GO TO 8                                                            A  79
7     READ (5,DUMMT) (BVI(I),I=1,N)                                      A  80
C                                                                        A  81
C     THE ROTATIONAL CONSTANT BE MAY BE FOUND BY EXTRAPOLATION, OR IT    A  82
C     MAY BE FIXED BY THE USER.                                          A  83
C     NEXT CARD CONTAINS IOPA AND BEQUIL.                                A  84
C     SET IOPA = 0, IF THE VALUE OF BE IS TO BE FOUND BY EXTRAPOLATION   A  85
C     FROM THE BV DATA READ IN.    LEAVE BEQUIL BLANK.                   A  86
C     SET IOPA = 1, IF THE VALUE OF BE IS TO BE GIVEN BY BEQUIL.         A  87
C     SET IOPA = 2, IF ROTATIONAL CONSTANTS ARE USED.    LEAVE BEQUIL    A  88
C     BLANK.                                                             A  89
C                                                                        A  90
8     READ (5,52) IOPA,BEQUIL                                            A  91
C                                                                        A  92
C     READ IN HIGHER TERMS IN EXPANSION DV,HV,COUPLING CONSTANT A,LAMDA,  A  93
C     GAMMA OEA MULLIKEN FORMULA,NUMBER OF J LEVELS TO BE CALCULATED NJ. A  94
C     AND IND (=1 2 3) TO INDICATE EXPANSION FORM 1 FOR SINGLET SIGMA    A  95
C     2 FOR DOUBLET PI 1/2 3 FOR DOUBLET PI 3/2                          A  96
C     IND=5 F1 DOUBLET SIGMA                                             A  97
C     IND F2 DOUBLET SIGMA                                               A  98
C                                                                        A  99
      READ (5,55) HV,LAM,NJ,GAM,IND                                      A 100
      READ (5,56) (DV(I),I=1,N)                                          A 101
      READ 56, (A(I),I=1,N)                                              A 102
C                                                                        A 103
C     READ ROTATIONAL LEVELS J                                           A 104
C                                                                        A 105
      READ (5,57) (J(I),I=1,NJ)                                          A 106
C                                                                        A 107
C     NEXT DATA CARD CONTAINS RE, THE INTERNUCLEAR EQUILIBRIUM DISTANCE. A 108
```

```
C                                                                       A 111
      READ (5,58) DE                                                    A 112
C                                                                       A 113
C     NEXT DATA CARD CONTAINS VSTART,VFIN,AND HDED WHERE                A 114
C     TURNING POINTS ARE CALCULATED FROM VIBRATIONAL LEVEL VSTART TO    A 115
C     VFIN IN STEPS OF HDED      E.G. FROM 0.5 TO 20.5 IN STEPS OF 1.0. A 116
C                                                                       A 117
      READ (5,52) VSTART,VFIN,HDED                                      A 118
C                                                                       A 119
C     NEXT CARD CONTAINS IOPEG.                                         A 120
C     SET IOPEG = 1, IF INTERMEDIATE STEPS IN THE EVALUATION OF THE     A 121
C     KLEIN ACTION INTEGRALS ARE TO BE PRINTED.                         A 122
C     SET IOPEG = 0, IF INTERMEDIATE PRINT-OUT IS TO BE SKIPPED.        A 123
C     NORMALLY THE USER SHOULD SET IOPEG = 0.                           A 124
C                                                                       A 125
      READ (5,50) IOPEG                                                 A 126
      READ 60, D2                                                       A 127
      READ 61, (D2(I),I=1,2)                                            A 128
C     THIS TERMINATES COMMENT CARDS ON THE PREPARATION OF DATA.         A 129
C     IF NO FURTHER PROBLEMS FOLLOW, REMEMBER TO ADD A BLANK CARD TO    A 130
C     THE DATA DECK.                                                    A 131
C                                                                       A 132
C                                                                       A 133
      QIRA(2)=6HANGST.                                                  A 134
      QIEN(2)=6H1/CM                                                    A 135
      QIMS(1)=6HC12=12                                                  A 136
      QIMS(2)=6HO16=16                                                  A 137
C                                                                       A 138
C      PRINT HEADING                                                    A 139
C                                                                       A 140
      WRITE (6,51) (EXT(I),I=1,16)                                      A 141
      WRITE (6,51) (EXT(I),I=1,16)                                      A 141
C                                                                       A 142
C      PRINT THE MASSES AND THEIR UNITS.                                A 143
C                                                                       A 144
      IF (ZMAS2) 10,10,9                                                A 145
9     WRITE (6,62) QIMS(IIMS),ZMAS1,ZMAS2                               A 146
      GO TO 11                                                          A 147
10    WRITE (6,63) QIMS(IIMS),ZMAS1                                     A 148
C                                                                       A 149
C                                                                       A 150
C      PRINT G(V) DATA, OR VIBRATIONAL CONSTANTS                        A 151
C                                                                       A 152
11    IF (ICHK) 12,13,12                                                A 153
12    WRITE (6,DTERMT)                                                  A 154
      WRITE (6,64) WE,WEXE,WEYE,WEZE,WETE                               A 155
      GO TO 14                                                          A 156
13    WRITE (6,65) QIEN(IIEN)                                           A 157
      WRITE (6,66) (G(I),I=1,N)                                         A 158
      WRITE (6,67)                                                      A 159
C                                                                       A 160
C      PRINT BV DATA, OR ROTATIONAL CONSTANTS                           A 161
C                                                                       A 162
14    IF (ICHK) 15,16,15                                                A 163
15    WRITE (6,DUEMT)                                                   A 164
```

```
      WRITE (6,68) BE,ALPHAE,GAMMAE,DELTAE,EPSLNE                    A 165
      GO TO 17                                                       A 166
16    WRITE (6,69) QIEN( IEB)                                        A 167
      WRITE (6,70) (BVI(I),I=1,N)                                    A 168
      WRITE (6,67)                                                   A 169
C                                                                    A 170
C     PRINT HEADING                                                  A 171
17    WRITE (6,51) (FMT(I),I=1,16)                                   A 172
C                                                                    A 173
      IF (ZMAS2) 18,18,19                                            A 174
18    ZMU=ZMAS1                                                      A 175
      GO TO 20                                                       A 176
19    ZMU=ZMAS1*ZMAS2/(ZMAS1+ZMAS2)                                  A 177
20    ZIMS(1)=1.0                                                    A 178
      ZIMS(2)=.9996784                                               A 179
      ZIRA(1)=1.0                                                    A 180
      ZIRA(2)=1.889766                                               A 181
      ZMU=ZMU*ZIMS(IIMS)                                             A 182
      ZIEN(1)=ZMU*3.64366E3                                          A 183
      ZIEN(2)=ZMU*1.6610826E-2                                       A 184
      ZIEN(3)=ZMU*1.339776E2                                         A 185
      FACM=60.201702/ZMU                                             A 186
      XI(1)=0.5                                                      A 187
      DO 21 I=2,N                                                    A 188
      IL=I-1                                                         A 189
      XI(I)=XI(IL)+1.0                                               A 190
21    CONTINUE                                                       A 191
      ZERO=0.0                                                       A 192
C                                                                    A 193
C     CALCULATE THE BV TO BE USED IN LATER COMPUTATION OF POTENTIALS A 194
C                                                                    A 195
      J1=0.                                                          A 196
      DO 40 LJ=1,NJ                                                  A 197
      J4=J(LJ)                                                       A 198
      LAM2=LAM*LAM                                                   A 199
C     IND=4 FOR TRIPLET SIGMA STATE                                  A 200
      GO TO (22,24,26,28,35,37,39,30), IND                           A 201
C                                                                    A 202
C     SINGLET SIGMA ELECTRONIC STATES                                A 203
C                                                                    A 204
22    J2=J4*(J4+1)                                                   A 205
      DO 23 I=1,N                                                    A 206
      BV(I)=BVI(I)-2.*DV(I)*J2+HV*J2*J2                              A 207
      BVE=BVI(I)*J2-DV(I)*J2*J2+HV*J2*J2*J2                          A 208
      G(I)=G(I)+BVE                                                  A 209
      GB(I)=G(I)                                                     A 210
23    CONTINUE                                                       A 211
      GO TO 41                                                       A 212
C                                                                    A 213
C     DOUBLET PI 1/2 ELECTRONIC STATE - HILL AND VAN VLECK-          A 214
C                                                                    A 215
C     P1                                                             A 216
24    JHAF2=(J4+.5)**2.                                              A 217
      J3=2*J4+1                                                      A 218
      J1=J4+(-1)**(IND+1)*.5                                         A 219
```

```
      DO 25 I=1,N                                                        A 220
      B=BV(I)$A1=A(I)$Y1=A1/B$D=DV(I)                                    A 221
      BV(I)=B*(1.-(4.*JHAF2+Y1*(Y1-4.)*LAM2)**-.5)-1/J3*(4.*D*J4**3.-.5* A 222
     1GAM)                                                               A 223
      BVE=B*(JHAF2-LAM2-.5*(4.*JHAF2+Y1*(Y1-4.)*LAM2)**.5)-D*J4**4.+.5*G A 224
     1AM*(J4-.5)                                                         A 225
      G(I)=GI(I)+BVE                                                     A 226
      GB(I)=G(I)                                                         A 227
25    CONTINUE                                                           A 228
      GO TO 41                                                           A 229
C                                                                        A 230
C     DOUBLET PI 3/2 ELECTRONIC STATE - HILL AND VAN VLECK-              A 231
C                                                                        A 232
C     F2                                                                 A 233
26    JHAF2=(J4+.5)**2.                                                  A 234
      J1=J4+(-1)**(IND+1)*.5                                             A 235
      J3=2*J4+1                                                          A 236
      DO 27 I=1,N                                                        A 237
      B=BV(I)$A1=A(I)$Y1=A1/B$D=DV(I)                                    A 238
      BV(I)=B*(1.+(4.*JHAF2+Y1*(Y1-4.)*LAM2)**-.5)-1./J3*(4*D*J4**3.+.5* A 239
     1GAM)                                                               A 240
      BVE=B*(JHAF2-LAM2+.5*(4.*JHAF2+Y1*(Y1-4.)*LAM2)**.5)-D*(J4+1.)**4. A 241
     1-.5*GAM*(J4+1.5)                                                   A 242
      G(I)=GI(I)+BVE                                                     A 243
      GB(I)=G(I)                                                         A 244
27    CONTINUE                                                           A 245
      GO TO 41                                                           A 246
C                                                                        A 247
C     TRIPLET SIGMA ELECTRONIC STATE                                     A 248
C                                                                        A 249
C     A-IS COUPLING PARAMETER LAMDA.A  IS EMPTY FOR THIS CALCULATION     A 250
C     J(PROGRAM)=K(PHYSICAL)                                             A 251
C     IFB=1 --- F1  ,IFB=2 --- F2  ,IFB=3 -- F3                          A 252
28    IFB=3                                                              A 253
      GO TO (29,31,33), IFB                                              A 254
C     F1                                                                 A 255
29    J3=2*J4+1                                                          A 256
      J2=J4*(J4+1)                                                       A 257
      DO 30 I=1,N                                                        A 258
      B=BV(I)$A1=A(I)$D=DV(I)                                            A 259
      J4B=(2*J4+3)*B                                                     A 260
      TSQ=J4B*J4B-A1*A1-2*A1*B                                           A 261
      TSQ=AMAX1(0.,TSQ)                                                  A 262
      TSQ=TSQ**.5                                                        A 263
      BV(I)=B-2*D*J2+1/J3*(2*B-2*J4B*B/TSQ+GAM)                          A 264
      BVE=B*J2-D*J2*J2+J4B-A1-TSQ+GAM*(J4+1)                             A 265
      G(I)=GI(I)+BVE                                                     A 266
      GB(I)=G(I)                                                         A 267
30    CONTINUE                                                           A 268
      GO TO 41                                                           A 269
C     F2                                                                 A 270
31    J2=J4*(J4+1)                                                       A 271
      DO 32 I=1,N                                                        A 272
      B=BV(I)$A1=A(I)$D=DV(I)                                            A 273
      BV(I)=B-2*D*J2                                                     A 274
```

```
      BVE=B*J2-D*J2*J2                                                  A 275
      G(I)=G(I)+BVE                                                     A 276
      GB(I)=G(I)                                                        A 277
32    CONTINUE                                                          A 278
      GO TO 41                                                          A 279
C     F3                                                                A 280
33    J2=J4*(J4+1)                                                      A 281
      J3=2*J4+1                                                         A 282
      DO 34 I=1,N                                                       A 283
      B=BV(I)$A1=A(I)$D=DV(I)                                           A 284
      J4B=(2*J4-1)*B                                                    A 285
      TSQ=J4B*J4B+A1*A1-2*A1*B                                          A 286
      TSQ=AMAX1(0.,TSQ)                                                 A 287
      TSQ=(TSQ)**.5                                                     A 288
      BV(I)=B-2*D*J2+1/J3*(-2*B+2*J4B*B/TSQ-GAM)                        A 289
      BVE=B*J2-J4B-A1+TSQ-GAM*J4-D*J2*J2                                A 290
      G(I)=G(I)+BVE                                                     A 291
      GB(I)=G(I)                                                        A 292
34    CONTINUE                                                          A 293
      GO TO 41                                                          A 294
C                                                                       A 295
C     DOUBLET SIGMA ELECTRONIC STATE                                    A 296
C                                                                       A 297
C     A=GAM FOR B IN THIS CALCULATION                                   A 298
C     J IS ACTUALLY K SINCE WE HAVE CASE B COUPLING                     A 299
C     F1                                                                A 300
35    J3=2*J4+1                                                         A 301
      J2=J4*(J4+1)                                                      A 302
      J1=J4                                                             A 303
      DO 36 I=1,N                                                       A 304
      B=BV(I)$C=A(I)$D=DV(I)                                            A 305
      BV(I)=B*(1.-2.*D*J2/B-C/(2.*J3*B))                                A 306
      BVE=B*J2-D*J2*J2-C*J2/2.                                          A 307
      G(I)=G(I)+BVE                                                     A 308
      GB(I)=G(I)                                                        A 309
36    CONTINUE                                                          A 310
      GO TO 41                                                          A 311
C     F2                                                                A 312
37    J3=2*J4+1                                                         A 313
      J2=J4*(J4+1)                                                      A 314
      J1=J4                                                             A 315
      DO 38 I=1,N                                                       A 316
      B=BV(I)$C=A(I)$D=DV(I)                                            A 317
      BV(I)=B*(1.-2.*D*J2/B+C/(B**2.*J3))                               A 318
      BVE=B*J2+C*J4/2.-D*J2*J2                                          A 319
      G(I)=G(I)+BVE                                                     A 320
      GB(I)=G(I)                                                        A 321
38    CONTINUE                                                          A 322
      GO TO 41                                                          A 323
C                                                                       A 324
C     DOUBLET PI ELECTRONIC STATE - ALMY AND HORSFALL -                 A 325
C                                                                       A 326
C     OH X2PI IS INVERTED  F2=(-)-J=K+1/2  AND F1=(+)-J=K-1/2           A 327
C     K IS READ IN MUST CONVERT TO J     IND=7 FOR F2  IND=8 FOR F1     A 328
C     J(PROGRAM)=K(PHYSICAL)   J1(PROGRAM)=J(PHYSICAL)                  A 329
```

```
39    J1=J(LJ)+(-1)**(IND-1)*.5                                          A 330
      J2=J1*J1+J1                                                        A 331
      DO 40 I=1,N                                                        A 332
      B=BV(I)                                                            A 333
      D=DV(I)                                                            A 334
      C=A(I)                                                             A 335
C     E=LAMDA=AV/BV                                                      A 336
      E=C/B                                                              A 337
C     F=MU=DV/BV                                                         A 338
      F=D/B                                                              A 339
      B1=B+2*D*J2-.5*D                                                   A 340
C     BA=ALPHA**.5                                                       A 341
      B2=1+F*(4*J2+1-2*F)+F*F*(2*J2-.5)*(2*J2-.5)-F*F                    A 342
      BA=(.25*F*F-F+1+(J2-.75)*B2)**.5                                   A 343
C      PARTIAL DERIVATIVE OF ALPHA = BP                                  A 344
      BP=.5/BA*(B2+(J2-.75)*(4*F+F*F*(4*J2-1)*2))                        A 345
C     7=IND FOR E1 ,8=IND FOR E2                                         A 346
      BV(I)=B1+(-1)**IND*D*BP                                            A 347
      EE=B*(J2-.75)+D*(J2*J2-.5*J2+13/16)+B*BA*(-1)**IND                 A 348
      G(I)=G(I)+EE                                                       A 349
      GB(I)=G(I)                                                         A 350
40    CONTINUE                                                           A 351
C     PRINT K AND J THE ROTATIONAL QUANTUM NUMBERSS FOR THIS PROBLEM     A 352
41    PRINT 71, J(LJ),J1                                                 A 353
C                                                                        A 354
C     PRINT GV BV JUST CALCULATED                                        A 355
C                                                                        A 356
      WRITE (6,72) DIEN(IIEN)                                            A 357
      WRITE (6,73) (G(I),I=1,N)                                          A 358
      WRITE (6,74) DIEN(IIEB)                                            A 359
      WRITE (6,75) (BV(I),I=1,N)                                         A 360
      PRINT 71, J(LJ),J1                                                 A 361
C                                                                        A 362
C     FIND ZERO POINT VARIABLES                                          A 363
C                                                                        A 364
      NINT=1                                                             A 365
      DO 42 I=1,6                                                        A 366
      XX(I)=I                                                            A 367
      YY(I)=DV(I)                                                        A 368
      YYY(I)=G(I)                                                        A 369
42    CONTINUE                                                           A 370
      SIGH(1)=XX(6)                                                      A 371
      NORDER=3                                                           A 372
      MPTS=6                                                             A 373
      CALL LSQPRT (XX,YY,NINT,NORDER,MPTS,SIGH,ANS)                      A 374
      REQUIL=ANS(1)+ANS(2)*(0.5)+ANS(3)*(.25)                            A 375
      CALL LSQPRT (XX,YYY,NINT,NORDER,MPTS,SIGH,ANS)                     A 376
      ZPTEN=ANS(1)+ANS(2)*(.5)+ANS(3)*(.25)                              A 377
      RE=4.1068530D6/(REQUIL*ZMAS1)**.5                                  A 378
      CALL RKB (RMIN,RMAX,YSTART,VEIN,HDED,NEIN,EV1,U,IQHK,IBHK,IQPEV,IQ A 379
     1RA,REQUIL,IQPEC)                                                   A 380
C     ADDED BLOCK OF PRINT OUT                                           A 381
C     REQUIRES ADDITIONAL DATA CARDS AT END OF DATA DECK                 A 382
C     DISOCIATION ENERGY - CARD 1 E8.2 D2                                A 383
C     DISOCIATION PRODUCTS - CARDS 2 A10 D3                              A 384
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      PRINT 51, (FMT(I),I=1,16)                                          A 385
      PRINT 76, (D3(I),I=1,2)                                            A 386
      D2F=D2/8066.02                                                     A 387
      PRINT 77, ZMAS1,D2,D2F                                             A 388
      PRINT 78, J(LJ),J1                                                 A 389
      PRINT 79                                                           A 390
      PRINT 80                                                           A 391
      ZE=0.0                                                             A 392
      PRINT 81, ZE,ZE,RE,ZE,REQUIL                                       A 393
      ASTAR=1H*                                                          A 394
      PUNCH 51, (FMT(I),I=1,8)                                           A 395
      PUNCH 82                                                           A 396
      L=0                                                                A 397
      DO 44 I=1,NFIN                                                     A 398
      G2=U(I)                                                            A 399
      G1=G2/8066.02                                                      A 400
      G3=G2/109737.039                                                   A 401
      RMI=RMIN(I)                                                        A 402
      RMA=RMAX(I)                                                        A 403
      RMI1=RMI/.529172                                                   A 404
      RMA1=RMA/.529172                                                   A 405
      VLEV=YI(I)                                                         A 406
      CH=VLEV-INT(VLEV)                                                  A 407
      IF (CH.GT..45.AND.CH.LT..55) GO TO 43                              A 408
      PRINT 86, VLEV,G1,RMI,RMA,G2,ASTAR                                 A 409
      GO TO 44                                                           A 410
43    L=L+1                                                              A 411
      LI=L-1                                                             A 412
      R1=RV(L)                                                           A 413
      A1=A(L)                                                            A 414
      D1=DV(L)                                                           A 415
      R11=RVI(L)                                                         A 416
      G2I=GI(L)                                                          A 417
      E=GR(L)                                                            A 418
      E1=E/8066.02                                                       A 419
      PRINT 85, VLEV,G1,RMI,RMA,G2,R1,E1,E,ASTAR,G2I,R11,D1,A1,LI        A 420
      PUNCH 83, LI,G2                                                    A 421
44    CONTINUE                                                           A 422
      PUNCH 84, RE,ZE                                                    A 423
      DO 45 I=1,NFIN                                                     A 424
      PUNCH 84, RMIN(I),U(I),RMAX(I),U(I)                                A 425
45    CONTINUE                                                           A 426
      IF (LJ.GT.1) GO TO 46                                              A 427
      RM=RMIN(NFIN)-.2                                                   A 428
      XMIN=AMAX1(0.,RM)                                                  A 429
      XMAX=RMAX(NFIN)+1.                                                 A 430
      YMAX=D2+20000.                                                     A 431
      CALL MAPG (XMIN,XMAX,0.,YMAX,.1,1.,.1,1.)                          A 432
      CALL ABSLINE (0.,0.,0.,1.)                                         A 433
      CALL ABSVECT (1.,1.)                                               A 434
      CALL ABSVECT (1.,0.)                                               A 435
      CALL ABSVECT (0.,0.)                                               A 436
      CALL ABSBEAM (.3,.05)                                              A 437
      CALL CHAROPT (0,0,0,0,0)                                           A 438
      CALL SYMBOL (10HRADIUS(ANGSTROMS)$.)                               A 439
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      CALL ABSPEAM (.25,.02)                                              A 440
      CALL SYMBOL (25HRKR POTENTIAL GENERATED$.)                          A 441
      CALL ABSPEAM (.65,.02)                                              A 442
      CALL SYMBOL (FMT)                                                   A 443
      CALL ABSPEAM (.05,.4)                                               A 444
      CALL CHAROPT (0.0,0.1.0)                                            A 445
      CALL SYMBOL (14HENERGY(CM-1)$.)                                     A 446
46    V(1)=GR(1)                                                          A 447
      V(1001)=RF                                                          A 448
      V(2001)=RF                                                          A 449
      DO 47 I=1,NFIN                                                      A 450
      K=I+1                                                               A 451
      V(K)=U(I)+GR(I)                                                     A 452
      V(1000+K)=RMIN(I)                                                   A 453
47    V(2000+K)=RMAX(I)                                                   A 454
      NPTS=NFIN+1                                                         A 455
      CALL LINES (V(1001),V(1),NPTS)                                      A 456
      CALL LINES (V(2001),V(1),NPTS)                                      A 457
      NL=J/LJ                                                             A 458
      CALL CHAROPT (0.0,0.0,0)                                            A 459
      CALL NUMBER (NL,7H2HJ=,I3)                                          A 460
48    CONTINUE                                                            A 461
      CALL FRAME                                                          A 462
      GO TO 1                                                             A 463
49    CALL EXIT                                                           A 464
C                                                                         A 465
50    FORMAT (I1)                                                         A 466
51    FORMAT (8A10)                                                       A 467
52    FORMAT (I4,2F10.0)                                                  A 468
53    FORMAT (2I4,4X,6A10)                                                A 469
54    FORMAT (5E10.3)                                                     A 470
55    FORMAT (E10.4,I1,I3,F10.4,I1)                                       A 471
56    FORMAT (8F10.0)                                                     A 472
57    FORMAT (10I3)                                                       A 473
58    FORMAT (F10.0)                                                      A 474
59    FORMAT (3E10.0)                                                     A 475
60    FORMAT (F9.2)                                                       A 476
61    FORMAT (2A10)                                                       A 477
62    FORMAT (///40H  THE MASSES OF THE TWO ATOMS, BASED ON A6,6H, ARE F  A 478
     110.6,5H AND F10.6///)                                               A 479
63    FORMAT (///46H  THE REDUCED MASS OF THE TWO ATOMS, BASED ON A6,5H,  A 480
     1 IS F10.6///)                                                       A 481
64    FORMAT (63H0 THE G(V) CURVE IS CONSTRUCTED FROM THE FOLLOWING INPU  A 482
     1T DATA, ///7H  RE = F10.3,8H, WEXE =F10.4,8H, WEYE =F10.3,8H, WEZE  A 483
     2=E10.3,8H, WETE =E10.3)                                             A 484
65    FORMAT (32H  THE INPUT G VALUES, ENERGY IN A6,18H, ARE GIVEN BELOW  A 485
     1.//)                                                                A 486
66    FORMAT (1X10F11.3)                                                  A 487
67    FORMAT (20X,48HVALUES OF -10. ARE TO BE FOUND BY INTERPOLATION.)    A 488
68    FORMAT (64H0 THE BV(V) CURVE IS CONSTRUCTED FROM THE FOLLOWING INP  A 489
     1UT DATA, ///7H  RE = 1PE11.5,10H, ALPHAE =E11.4,10H, GAMMAE =E11.4,  A 490
     210H, DELTAE =E11.4,10H, EPSLNE =E11.4)                              A 491
69    FORMAT (33H  THE INPUT BV VALUES, ENERGY IN A6,18H, ARE GIVEN BELO  A 492
     1W.//)                                                               A 493
70    FORMAT (1X10E11.6)                                                  A 494
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71    FORMAT (4H1K= ,I3,4H J= ,F4.1)                                          A 495
72    FORMAT (61H  THE FOLLOWING NUMBERS ARE THE MODIFIED G VALUES, ENER      A 496
     1GY IN ,A6,17H ARE GIVEN BELOW,//)                                       A 497
73    FORMAT (1X10F11.3)                                                      A 498
74    FORMAT (46H THE FOLLOWING ARE THE MODIFIED BV, ENERGY IN A6,//)         A 499
75    FORMAT (1X10F11.6)                                                      A 500
76    FORMAT (1HO,6X,29HDISSOCIATION PRODUCTS ARE     ,2A10)                  A 501
77    FORMAT (1HO,6X,13HREDUCED MASS=,F9.5,6X,21HDISSOCIATION ENERGY =,F      A 502
     1O.2,6H 1/CM=,F9.4,3H EV)                                                A 503
78    FORMAT (1HO,5X,17HROTATIONAL LEVEL ,4X,2HK=,I5,7X,2HJ=,F5.1//)          A 504
79    FORMAT (28X,15HCALCULATED DATA,47X,17HEXPERIMENTAL DATA//)              A 505
80    FORMAT (4H  V=,5X,6HGV(EV),3X,7HRMIN(A),2X,7HRMAX(A),3X,8HGV(1/CM)      A 506
     1,2X,8HBV(1/CM),3X,5HE(EV),3X,7HE(1/CM),4X,1H*,4X,8HGV(1/CM),3X,8HB     A 507
     2V(1/CM),3X,8HDV(1/CM),3X,8HAV(1/CM),3X,1HV/)                            A 508
81    FORMAT (2X,F3.1,2X,F9.6,6X,F7.4,7X,F9.3,2X,F8.4)                        A 509
82    FORMAT (11H KV,ETRIAL )                                                 A 510
83    FORMAT (I10,F10.3)                                                      A 511
84    FORMAT (4F12.5)                                                         A 512
85    FORMAT (1H ,F4.1,2X,F9.6,2X,F7.4,2X,F7.4,2X,F9.3,2X,F8.4,2X,F6.3,3      A 513
     1X,F7.1,4X,A1,4X,F8.2,3X,F8.4,2X,F9.3,3X,F8.2,3X,I2)                     A 514
86    FORMAT (1H ,F4.1,2X,F9.6,2X,F7.4,2X,F7.4,2X,F9.3,32X,A1)                A 515
      END                                                                     A 516-
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      SUBROUTINE RKR (RMIN,RMAX,VSTA,VFIN,HDES,M,EV1,U,IQHK,IPHK,IOPEV,I   R    1
     1OPA,REQUIL,IOPEG)                                                    R    2
C     RKR  FINDS TURNING POINTS FROM G(V) AND BV DATA, OR FROM CONSTANT    R    3
      DIMENSION JEV(3000), EV(3000), BV(200), BI(3000), TEMP(200), U(200   R    4
     1), RMIN(200), RMAX(200), Y(200), Z(200), ZOC(9), MZ(5), IZ(5), IR(   R    5
     24O), IG(40)                                                          R    6
      DIMENSION V(200), G(200), BD(200), OEV(200), OV(200), XG(20), YG(2   R    7
     10), ZG(20), EPSH(1), AGAUS(5,20), XGAUS(5,20), VSTA(1), VFIN(1), H   R    8
     2DES(1), DENQ(20), FLE(1), ANS(3), YY(6), XEE(1), SIGH(1), XX(6), U   R    9
     3UU(200), T(40), RT(40), IX(30), UX(30)                               R   10
      DIMENSION OEVP(200), OVP(200)                                        R   11
      COMMON Y,TEMP,JEV,EV,Q,NST,N,MST,D,XMIN,XMAX,INSC,NREG,NUSED,BI,NI   R   12
     1,NS,MAXIT,FACM,ZMU,DE,WE,WEXE,WEYE,WEZE,WETE,BE,ALPHAE,GAMMAE,DELT   R   13
     2AE,VMIN,BQ,MG,SREP,UUU,BV,Z,ICK,H,K,HDES,EPSLNE,XX,BBBBB,ZPTEN,VL   R   14
     3V,LV,BF                                                              R   15
      GFUNCF(X)=((((((((WETE*X)+WEZE)*X)+WEYE)*X)-WEXE)*X)+WE)*X           R   16
      BFUNCF(X)=((((((EPSLNE*X)+DELTAE)*X)+GAMMAE)*X)-ALPHAE)*X)+BE        R   17
C      FAC = (HPLANCK*NAV/8*PI**2*C)**.5*E8/ZMU**.5                        R   18
      FAC=4.105785E9/SQRT(ZMU)                                             R   19
      NPROP=1                                                              R   20
      MUST=8                                                               R   21
      EV1=0.0                                                              R   22
      CALL SECOND (BEGIN)                                                  R   23
C                                                                          R   24
C      TURNING POINTS FOUND FOR V = VSTA,VFIN,HDES.                        R   25
C                                                                          R   26
C     INTERPOLATE G(V) AND BV DATA                                         R   27
C                                                                          R   28
      JJ=0                                                                 R   29
      JK=0                                                                 R   30
      IJ=0                                                                 R   31
      IK=0                                                                 R   32
      HDES=.01                                                             R   33
      NREG=1                                                               R   34
      IF (IOPEV-1) 2,1,2                                                   R   35
1     EV1=Z(1)                                                             R   36
      WRITE (6,107) MUST                                                   R   37
      DO 8 I=1,N                                                           R   38
      IF (Z(I)+10.) 3,4,4                                                  R   39
3     IJ=IJ+1                                                              R   40
      TEMP(IJ)=Y(I)                                                        R   41
      U(IJ)=Z(I)                                                           R   42
      GO TO 5                                                              R   43
4     JJ=JJ+1                                                              R   44
      OEV(JJ)=Y(I)                                                         R   45
      IG(JJ)=I                                                             R   46
5     IF (BV(I)+10.) 6,7,6                                                 R   47
6     IK=IK+1                                                              R   48
      RMIN(IK)=Y(I)                                                        R   49
      RMAX(IK)=BV(I)                                                       R   50
      GO TO 8                                                              R   51
7     JK=JK+1                                                              R   52
      EV(JK)=Y(I)                                                          R   53
      IR(JK)=I                                                             R   54
8     CONTINUE                                                             R   55
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      IF (JJ) 12,12,9                                                    R  56
9     CALL NTRPSR (TEMP,U,UEV,PI,HDES,IJ,JJ,VNIN,VN,INSC,MREG,NUST)      R  57
      LOC=8                                                              R  58
      IF (INSC) 97,10,97                                                 R  59
10    DO 11 I=1,JJ                                                       R  60
      IJ=IS(I)                                                           R  61
      Z(IJ)=PI(I)                                                        R  62
11    CONTINUE                                                           R  63
12    IF (JK) 16,16,13                                                   R  64
13    CALL NTRPSR (RMIN,RMAX,EV,PI,HDES,IK,JK,VNIN,VN,INSC,MREG,NUST)    R  65
      LOC=9                                                              R  66
      IF (INSC) 97,14,97                                                 R  67
14    DO 15 I=1,JK                                                       R  68
      IK=IR(I)                                                           R  69
      RV(IK)=PI(I)                                                       R  70
15    CONTINUE                                                           R  71
16    IF (IQHK) 17,19,17                                                 R  72
17    EV1=-GFUNCF(0.,6)                                                  R  73
      IOPEV=0                                                            R  74
      DO 18 I=1,N                                                        R  75
      Z(I)=GFUNCF(Y(I))+EV1                                              R  76
18    CONTINUE                                                           R  77
      GO TO 22                                                           R  78
19    INTG=INTG                                                          R  79
      MREG=1                                                             R  80
      M=1                                                                R  81
      UEV(1)=0.                                                          R  82
      HDES=1.                                                            R  83
      EV1=-EV1                                                           R  84
      IF (EV1) 22,20,20                                                  R  85
20    CALL NTRPSR (Y,Z,UEV,EV,HDES,N,M,VNIN,VN,INSC,MREG,NUST)           R  86
      LOC=1                                                              R  87
      IF (INSC) 97,21,97                                                 R  88
21    EV1=EV(1)                                                          R  89
C     EV1 NOW CONTAINS THE ZERO POINT ENERGY BY EXTRAPOLATION.           R  90
      EV1=ZPTEN                                                          R  91
22    IF (IRHK) 23,25,23                                                 R  92
23    EV(1)=RE                                                           R  93
      DO 24 I=1,N                                                        R  94
      RV(I)=GFUNCF(Y(I))                                                 R  95
24    CONTINUE                                                           R  96
      GO TO 28                                                           R  97
25    IF (IQRA) 26,27,26                                                 R  98
26    EV(1)=REQUIL                                                       R  99
      GO TO 28                                                           R 100
27    CALL NTRPSR (Y,RV,UEV,EV,HDES,N,M,VNIN,VN,INSC,MREG,NUST)          R 101
C     EV(1) NOW CONTAINS RE BY EXTRAPOLATION                             R 102
      LOC=7                                                              R 103
      IF (INSC) 97,28,97                                                 R 104
28    V(1)=0.                                                            R 105
      S(1)=0.                                                            R 106
      RO(1)=EV(1)                                                        R 107
      DO 29 I=1,N                                                        R 108
      V(I+1)=Y(I)                                                        R 109
      S(I+1)=Z(I)                                                        R 110
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      PO(I+1)=PV(I)                                                     P 111
29    CONTINUE                                                          P 112
      NP=N+1                                                            P 113
      IF (IOPEV) 30,31,30                                               P 114
30    CONTINUE                                                          P 115
      EV1=EV1+G(2)                                                      P 116
31    DO 32 I=2,NP                                                      P 117
      G(I)=G(I)-EV1                                                     P 118
      Y(I)=V(I)                                                         P 119
      Z(I)=G(I)                                                         P 120
      PV(I)=PO(I)                                                       P 121
32    CONTINUE                                                          P 122
      IF (IOPEV) 33,34,33                                               P 123
33    EV1=-G(2)                                                         P 124
34    IF (NPOP-17) 37,35,37                                             P 125
35    M=1                                                               P 126
      EV(1)=OE                                                          P 127
      CALL NTPRSP (Z,Y,EV,UEV,HOES,NP,M,VNIN,VN,INSC,NREG,NUST)         P 128
      LOC=2                                                             P 129
      IF (INSC) 37,36,37                                                P 130
36    NP=NP+1                                                           P 131
      Y(NP)=UEV                                                         P 132
      V(NP)=UEV                                                         P 133
      Z(NP)=OE                                                          P 134
      G(NP)=OE                                                          P 135
      PO(NP)=0.                                                         P 136
      PV(NP)=0.                                                         P 137
37    Y(1)=0.                                                           P 138
      Z(1)=0.                                                           P 139
      PV(1)=PO(1)                                                       P 140
      VN1N=VSTA                                                         P 141
      VN=VEIN                                                           P 142
      HOES=HOED                                                         P 143
      M=0                                                               P 144
      WRITE (6,103) (Y(I),Z(I),I=1,NP)                                  P 145
      WRITE (6,103) (Y(I),PV(I),I=1,NP)                                 P 146
      IF (IOUT) 38,40,38                                                P 147
38    M=(VEIN-VSTA)/HOED+1.                                             P 148
      DO 39 I=1,M                                                       P 149
      OEV(I)=VSTA+FLOATF(I-1)*HOED                                      P 150
      OEVSR(I)=OEV(I)                                                   P 151
      EV(I)=FUNCF(OEVSR(I))                                             P 152
      OVR(I)=OV(I)                                                      P 153
      OEVR(I)=OEV(I)                                                    P 154
39    CONTINUE                                                          P 155
      INSC=0                                                            P 156
      GO TO 41                                                          P 157
40    CALL NTPRSP (V,G,OEV,OV,HOED,NP,M,VSTA,VEIN,INSC,NREG,NUST)       P 158
      LOC=2                                                             P 159
      WRITE (6,110) HOES,VN1N,VN,NREG,NUST,INSC,NP,M                    P 160
41    WRITE (6,111)                                                     P 161
      PRINT 112, (OEV(I),OV(I),I=1,M)                                   P 162
      IF (INSC) 37,42,37                                                P 163
42    DO 43 I=1,M                                                       P 164
      EVR(I)=OEV(I)                                                     P 165
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      U(I)=OV(I)                                                        P 166
43    CONTINUE                                                          P 167
C                                                                       P 168
C     INTEGRATION CONSTANTS                                             P 169
C                                                                       P 170
      STEP=.9                                                           P 171
      MZ(1)=101                                                         P 172
      MZ(2)=81                                                          P 173
      MZ(3)=61                                                          P 174
      IZ(1)=8                                                           P 175
      XGAUS(1,1)=.0198550717512J2                                       P 176
      XGAUS(1,2)=.1016667612931?6                                       P 177
      XGAUS(1,3)=.2372337955041836                                      P 178
      XGAUS(1,4)=.4082826787?*2175                                      P 179
      XGAUS(1,5)=1.-XGAUS(1,4.                                          P 180
      XGAUS(1,6)=1.-XGAUS(1,3)                                          P 181
      XGAUS(1,7)=1.-XGAUS(1,2)                                          P 182
      XGAUS(1,8)=1.-XGAUS(1,1)                                          P 183
      AGAUS(1,1)=.050614268145188                                       P 184
      AGAUS(1,2)=.111190517224497                                       P 185
      AGAUS(1,3)=.156853322938944                                       P 186
      AGAUS(1,4)=.181341891689181                                       P 187
      AGAUS(1,5)=AGAUS(1,4)                                             P 188
      AGAUS(1,6)=AGAUS(1,3)                                             P 189
      AGAUS(1,7)=AGAUS(1,2)                                             P 190
      AGAUS(1,8)=AGAUS(1,1)                                             P 191
      IZ(2)=6                                                           P 192
      XGAUS(2,1)=.033765242898424                                       P 193
      XGAUS(2,2)=.169395306766868                                       P 194
      XGAUS(2,3)=.380690406958402                                       P 195
      XGAUS(2,4)=1.-XGAUS(2,3)                                          P 196
      XGAUS(2,5)=1.-XGAUS(2,2)                                          P 197
      XGAUS(2,6)=1.-XGAUS(2,1)                                          P 198
      AGAUS(2,1)=.085662246189585                                       P 199
      AGAUS(2,2)=.180380786524070                                       P 200
      AGAUS(2,3)=.233956967286345                                       P 201
      AGAUS(2,4)=AGAUS(2,3)                                             P 202
      AGAUS(2,5)=AGAUS(2,2)                                             P 203
      AGAUS(2,6)=AGAUS(2,1)                                             P 204
      IZ(3)=4                                                           P 205
      XGAUS(3,1)=.069431844202974                                       P 206
      XGAUS(3,2)=.330009478207572                                       P 207
      XGAUS(3,3)=1.-XGAUS(3,2)                                          P 208
      XGAUS(3,4)=1.-XGAUS(3,1)                                          P 209
      AGAUS(3,1)=.173027422568727                                       P 210
      AGAUS(3,2)=.326072577431273                                       P 211
      AGAUS(3,3)=AGAUS(3,2)                                             P 212
      AGAUS(3,4)=AGAUS(3,1)                                             P 213
      ZG(1)=ZG(3)                                                       P 214
      WRITE (6,113)                                                     P 215
      DO 94 I=1,N                                                       P 216
      TEMP(I=OEV(I)                                                     P 217
      NUS2=NUST/2                                                       P 218
      NP=NUS2+1                                                         P 219
      NE=N-NP+1                                                         P 220
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```
      DO 44 J=NP,NF                                                     R 221
      IF (TEMPI-V(J)) 45,45,44                                          R 222
44    CONTINUE                                                          R 223
      ISG=NF+1                                                          R 224
      GO TO 46                                                          R 225
45    ISG=J                                                             R 226
46    NSTA=ISG-NUS2                                                     R 227
      VMIN=0.                                                           R 228
      EEG=0.                                                            R 229
      GEG=0.                                                            R 230
      LT=1                                                              R 231
      IZGO=0                                                            R 232
      GDO=0.                                                            R 233
      EDO=0.                                                            R 234
      ISG=0                                                             R 235
      ISB=0                                                             R 236
C                                                                       R 237
C     COMMENCE FINDING TURNING POINTS BY INTEGRATION                    R 238
C                                                                       R 239
      CALL SECOND (BEGIA)                                               R 240
47    BS=VMIN+(TEMPI-VMIN)*STEP                                         R 241
      IF (LT-3) 48,48,57                                                R 242
48    MO=MZ(LT)                                                         R 243
      KM=(MO-1)/2                                                       R 244
      TMIN=VMIN                                                         R 245
      TS=BS                                                             R 246
      A=(TS-TMIN)/FLOATF(MO-1)                                          R 247
      MX=0                                                              R 248
      IF (IOWK) 100,49,100                                              R 249
49    CALL NTRPSB (Y,Z,UEV,EV,A,NP,MX,TMIN,TS,INSC,MREG,NUST)           R 250
      LOC=3                                                             R 251
      IF (INSC) 97,50,97                                                R 252
50    IF (GDO) 53,51,53                                                 R 253
51    MX=0                                                              R 254
      IF (IOWK) 102,52,102                                              R 255
52    CALL NTRPSB (Y,BV,UEV,BI,A,NP,MX,TMIN,TS,INSC,MREG,NUST)          R 256
      LOC=4                                                             R 257
      IF (INSC) 97,53,97                                                R 258
53    DO 55 J=1,MO                                                      R 259
      DENO=U(I)-EV(J)                                                   R 260
      IF (DENO) 99,99,54                                                R 261
54    UEV(J)=1./SORTF(DENO)                                             R 262
      EV(J)=BI(J)*UEV(J)                                                R 263
55    CONTINUE                                                          R 264
      ESUM=UEV(1)+4.*UEV(2)+UEV(MO)                                     R 265
      GSUM=EV(1)+4.*EV(2)+EV(MO)                                        R 266
      DO 56 J=2,KM                                                      R 267
      ESUM=ESUM+4.*UEV(2*J)+2.*UEV(2*J-1)                               R 268
      GSUM=GSUM+4.*EV(2*J)+2.*EV(2*J-1)                                 R 269
56    CONTINUE                                                          R 270
      EEG=A*ESUM/3.                                                     R 271
      GEG=A*GSUM/3.                                                     R 272
      IF (LT-1) 96,96,58                                                R 273
57    IZGO=(LT-1)/3                                                     R 274
      IF (IZGO-3) 58,58,59                                              R 275
```

```
58      IZDO=3                                                          B 276
59      NGAS=IZ(IZDO)                                                   B 277
        DO 60 J=1,NGAS                                                  B 278
        XG(J)=(BS-VMIN)*XGAUS(IZDO,J)+VMIN                              B 279
        UEV(J)=XG(J)                                                    B 280
60      CONTINUE                                                        B 281
        MST=1                                                           B 282
        EPSH=TEMP1-XG(NGAS)                                             B 283
        EPS=EPSH                                                        B 284
        IF (EPSH(1)) 93,61,62                                           B 285
61      IF (EPSH(2)) 93,93,62                                           B 286
62      IF (IQHK) 104,63,104                                            B 287
63      CALL NTRPSR (V,G,XG,YG,EPSH,NP,NGAS,VMIN,BS,INSC,MST,NUST)      B 288
        LOC=5                                                           B 289
        IF (INSC) 97,64,97                                              B 290
64      IF (IZGO) 65,65,75                                              B 291
65      IF (GDO) 68,66,68                                               B 292
66      MST=1                                                           B 293
        IF (IBHK) 105,67,105                                            B 294
67      CALL NTRPSR (Y,BV,UEV,BI,EPS,NP,NGAS,TMIN,TS,INSC,MST,NUST)     B 295
        LOC=6                                                           B 296
        IF (INSC) 97,68,97                                              B 297
68      FSUM=0.0                                                        B 298
        GSUM=0.0                                                        B 299
        DO 72 J=1,NGAS                                                  B 300
        IF (IQHK) 70,69,70                                              B 301
69      DENO(J)=OV(I)-YG(J)                                             B 302
70      IF (DENO(J)) 99,99,71                                           B 303
71      XG(J)=AGAUS(IZDO,J)/SQRTF(DENO(J))                              B 304
        YG(J)=BI(J)*XG(J)                                               B 305
        FSUM=FSUM+XG(J)                                                 B 306
        GSUM=GSUM+YG(J)                                                 B 307
72      CONTINUE                                                        B 308
        IF (BI(NGAS)-BI(1)) 74,73,74                                    B 309
73      IZGO=1                                                          B 310
74      BSV=BS-VMIN                                                     B 311
        FEG2=BSV*FSUM                                                   B 312
        GEG2=BSV*GSUM                                                   B 313
        GO TO 78                                                        B 314
75      FSUM=0.0                                                        B 315
        DO 77 J=1,NGAS                                                  B 316
        DENO=OV(I)-YG(J)                                                B 317
        IF (DENO) 99,99,76                                              B 318
76      XG(J)=AGAUS(IZDO,J)/SQRTF(DENO)                                 B 319
        FSUM=FSUM+XG(J)                                                 B 320
77      CONTINUE                                                        B 321
        GSUM=BI(NGAS)*FSUM                                              B 322
        GO TO 74                                                        B 323
78      IF (FEG2/FEG-1.E-6) 79,79,80                                    B 324
79      FDO=1.                                                          B 325
80      IF (GEG2/GEG-1.E-6) 81,81,82                                    B 326
81      GDO=1.                                                          B 327
82      IF (ABSF(FEG2/FEG1)-.9) 84,84,83                                B 328
83      FDO=1.                                                          B 329
84      IF (ABSF(GEG2/GEG1)-.9) 86,86,85                                B 330
```

```
85      GDO=1.                                                          B 331
86      LT=LT+1                                                         B 332
        FEG1=FEG2                                                       B 333
        GEG1=GEG2                                                       B 334
        IF (FDO) 88,87,88                                               B 335
87      FEG=FEG+FEG2                                                    B 336
        IF (GDO) 90,89,90                                               B 337
88      IF (GDO) 93,89,93                                               B 338
89      GEG=GEG+GEG2                                                    B 339
90      YMIN=BS                                                         B 340
        IF (IOPEG) 91,92,91                                             B 341
91      CALL SECOND (AFTEA)                                             B 342
        XTIO=(AFTEA-BEGIA)                                              B 343
        BEGIA=AFTEA                                                     B 344
        WRITE (6,114) FEG,GEG,XTIO                                      B 345
92      IF (LT-20) 47,47,98                                             B 346
93      F=FEG*FAC                                                       B 347
        GF=GEG/FAC                                                      B 348
        RMAX(I)=SQRTF(F*F+F/GF)+F                                       B 349
        RMIN(I)=RMAX(I)-2.*F                                            B 350
        CALL SECOND (AFTER)                                             B 351
        XTIO=AFTER-BEGIN                                                B 352
        BEGIN=AFTER                                                     B 353
C       WRITEOUTPUTTAPE6,104,TEMPI,U(I),RMIN(I),RMAX(I),XTIO,BI(NGAS)   B 354
        TEMPII=TEMPI                                                    B 355
        WRITE (6,115) TEMPII,U(I),RMIN(I),RMAX(I),XTIO,BI(NGAS),F,GF    B 356
94      CONTINUE                                                        B 357
        DO 95 I=1,N                                                     B 358
        Z(I)=Z(I+1)                                                     B 359
        Y(I)=Y(I+1)                                                     B 360
        BV(I)=BV(I+1)                                                   B 361
95      CONTINUE                                                        B 362
        WRITE (6,113)                                                   B 363
96      RETURN                                                          B 364
97      ZOC(1)=6H EV1                                                   B 365
        ZOC(2)=6HG(LEV)                                                 B 366
        ZOC(3)=6HS,P,EV                                                 B 367
        ZOC(4)=6HS,P,BV                                                 B 368
        ZOC(5)=6HD,P,EV                                                 B 369
        ZOC(6)=6HD,P,BV                                                 B 370
        ZOC(7)=6H BV1                                                   B 371
        ZOC(8)=6HS FILL                                                 B 372
        ZOC(9)=6HBVFILL                                                 B 373
        WRITE (6,116) ZOC(LOC),U(I)                                     B 374
        INTG=1                                                          B 375
        GO TO 96                                                        B 376
98      WRITE (6,117)                                                   B 377
        INTG=1                                                          B 378
        GO TO 96                                                        B 379
99      INTG=1                                                          B 380
        WRITE (6,118)                                                   B 381
        GO TO 96                                                        B 382
100     VX=MO                                                           B 383
        DO 101 J=1,MO                                                   B 384
        UEV(J)=YMIN+FLOATF(J-1)*A                                       B 385
```

```
      EV(J)=GFUNCF(UEV(J))                                              B 386
101   CONTINUE                                                          B 387
      GO TO 50                                                          B 388
102   MX=MQ                                                             B 389
      DO 103 J=1,MQ                                                     B 390
      UEV(J)=TMIN+FLOATF(J-1)*A                                         B 391
      BI(J)=BFUNCF(UEV(J))                                              B 392
103   CONTINUE                                                          B 393
      GO TO 53                                                          B 394
104   CALL DGUNC (XG,DENO,NGAS,TEMPI)                                   B 395
      GO TO 64                                                          B 396
105   DO 106 J=1,NGAS                                                   B 397
      BI(J)=BFUNCF(UEV(J))                                              B 398
106   CONTINUE                                                          B 399
      GO TO 68                                                          B 400
C                                                                       B 401
107   FORMAT (20HO NUSED IN BESRKR = I2,1H.)                            B 402
108   FORMAT (32HO THE G(V) VALUES USED BELOW ARE//,6X,6(2X,1HV7X,1HG10X B 403
     1),/,(6(F10.1,F11.4)))                                             B 404
109   FORMAT (33HO THE BV(V) VALUES USED BELOW ARE//,6X,6(2X,1HV6X,2HBV1 B 405
     10X),/,(6(F10.1,F11.7)))                                           B 406
110   FORMAT (6HOHDES=1PE15.7,7H, VMIN=E15.7,5H, VN=E15.7,7H, MBEG=I5/9X B 407
     1,7H, NUST=I5,7H, INSC=I5,4H, N=I5,4H, M=I5)                       B 408
111   FORMAT (54HO OUTPUT V,G--LEVELS AT WHICH TURNING POINTS ARE FOUND/ B 409
     1/,6X,6(2X,1HV7X,1HG10X)/)                                         B 410
112   FORMAT (6(F10.1,F11.4))                                           B 411
113   FORMAT (1H1)                                                      B 412
114   FORMAT (6X,6HEEG = 1PE15.7,8H, GEG = E15.7,10X,9HREQUIRED 0PF8.3,9 B 413
     1H SECONDS.)                                                       B 414
115   FORMAT (10HO FOR V = F5.1,3X,6H G =  F10.3,14H 1/CM, RMIN = F10.7, B 415
     112H AND RMAX = F10.7,27H ANGSTROMS.  THIS REQUIRED F8.3,9H SECONDS B 416
     2./20X,12H ALSO, BV = F12.7/20X,49H THE KLEIN ACTION INTEGRALS F AN B 417
     3D G ARE EQUAL TO 2F15.8///)                                       B 418
116   FORMAT (26HO NTRPDP UNSUCCESSFUL FOR A6,11H, WHEN U = F16.8)      B 419
117   FORMAT (20HO TFG REACHED MAXIT )                                  B 420
118   FORMAT (22HO DENO IS NOT POSITIVE)                                B 421
      END                                                               B 422-
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```
      SUBROUTINE NTRPSR (XJ,YJ,YO,YO,XN,N,K,XNIN,XNAX,INSC,MBEG,NUSED)    C   1
C     NTRPSR  INTERPOLATION PROGRAM (BY SUCCESSIVE RANGES)  SINGLE PREC.   C   2
C                                                                           C   3
C      THE METHOD OF LAGRANGE IS USED.  THE INPUT POINTS NEED NOT BE        C   4
C      EQUALLY SPACED.  THERE ARE TWO MODES OF INPUT AVAILABLE.  THE        C   5
C      FIRST OCCURS WHEN M = 0.  THE ABSCISSAE ARE THEN GENERATED FROM      C   6
C      XMIN,XMAX,AND XH.  AT EXIT M = NO. OF POINTS FOUND, AND XO           C   7
C      CONTAINS THE ABSCISSAE.  M WILL BE CHECKED TO INSURE THAT THE        C   8
C      DIMENSION IS NOT EXCEEDED.  MDIMM = THE DIMENSION OF THE XO, YO      C   9
C      ARRAYS.  THE SECOND MODE OCCURS WHEN M IS POSITIVE.  THE M           C  10
C      ABSCISSAE ARE THEN ASSUMED TO HAVE BEEN GENERATED PRIOR TO           C  11
C      ENTRY.  THE STARTING INDEX FOR THE OUTPUT ARRAY MUST BE              C  12
C      SPECIFIED.  THE FIRST POINT FOUND WILL BE AT XO(MBEG).  XH MUST      C  13
C      BE GIVEN SINCE THE ORDINATE FOR ANY POINT CLOSER THAN .01*XH TO      C  14
C      AN INPUT POINT IS TAKEN AS THAT FOR THE INPUT POINT.  -NUSED- IS     C  15
C      THE NUMBER OF POINTS USED FOR EACH INTERPOLATED POINT.  *NUSED*      C  16
C      MUST BE EVEN AND LESS THAN OR EQUAL TO -N-.  NUSED = 8 IS            C  17
C      SUGGESTED.  ANY POINT FARTHER THAN NUSED/2 POINTS FROM EITHER END    C  18
C      IS FOUND FROM THE NUSED/2 ON EACH SIDE.  NTRPSR WILL SCALE AND       C  19
C      RESCALE IN ORDER TO AVOID OVERFLOW.  IF THE FIRST SCALING DOES       C  20
C      NOT SUCCEED, NTRPSR WILL TRY UP TO 7 TIMES MORE BEFORE RETURNING     C  21
C      IN THE ERROR MODE. (INSC = 1)                                        C  22
C      INPUT IS  XI,YI,(XO),XH,N,M,(XMIN),(XMAX),MBEG,NUSED.                C  23
C      OUTPUT IS  (XO),YO,INSC.                                             C  24
C      INSC = 0 IF PROGRAM WAS SUCCESSFUL.  IF NOT, INSC = 1.               C  25
C                                                                           C  26
      DIMENSION XI(200), YI(200), XO(3000), YO(3000), XJ(200), YJ(200),    C  27
     1NUMB(200)                                                            C  28
      MDIMM=3000                                                           C  29
      XMAX=XNAX                                                            C  30
      XMIN=XNIN                                                            C  31
      XH=ABSF(XH)                                                          C  32
      M=K                                                                  C  33
      IREV=0                                                               C  34
      IREX=0                                                               C  35
C     M IS ZERO, IF XH, XMIN, XMAX ARE TO BE USED.  IF M IS NOT = TO       C  36
C     ZERO, THEN XO(I), I = 1,M WILL BE USED AS ABSCISSA.                  C  37
      IF (M) 32,1,6                                                        C  38
1     M=XINTF(ABSF((XMAX-XMIN)/XH))+1                                      C  39
C     IF M IS MORE THAN DIMENSION OF XO, RETURN IN ERROR MODE.             C  40
      IF (M+MBEG-MDIMM-2) 2,33,33                                          C  41
2     ME=MBEG+M-1                                                          C  42
      IF (XMAX-XMIN) 3,4,4                                                 C  43
3     XMIN=XMAX                                                            C  44
      XMAX=XMIN                                                            C  45
      IREV=1                                                               C  46
4     DO 5 I=MBEG,ME                                                       C  47
      XO(I)=FLOATF(I-MBEG)*XH+XMIN                                         C  48
5     CONTINUE                                                             C  49
6     DO 7 I=1,N                                                           C  50
      XI(I)=XJ(I)                                                          C  51
7     CONTINUE                                                             C  52
      ME=MBEG+M-1                                                          C  53
      MSTA=MBEG                                                            C  54
      NUST=NUSED/2                                                         C  55
```

```
      NS=NUST+1                                                          C  56
      NF=N-NS+1                                                          C  57
      NFP=NF+1                                                           C  58
      DO 9 I=NS,NFP                                                      C  59
      NUMB(I)=0                                                          C  60
    8 CONTINUE                                                           C  61
      IF (XO(MF)-XO(MREG)) 9,11,11                                       C  62
    9 M2=M/2                                                             C  63
      M2F=MREG+M2-1                                                      C  64
      DO 10 I=MREG,M2F                                                   C  65
      K=MF+MREG-I                                                        C  66
      TEMP=XO(I)                                                         C  67
      XO(I)=XO(K)                                                        C  68
      XO(K)=TEMP                                                         C  69
   10 CONTINUE                                                           C  70
      IREV=1                                                             C  71
   11 IF (XI(N)-XI(1)) 12,14,14                                          C  72
   12 N2=N/2                                                             C  73
      DO 13 I=1,N2                                                       C  74
      K=N+1-I                                                            C  75
      TEMP=XJ(I)                                                         C  76
      TEMS=YJ(I)                                                         C  77
      XJ(I)=XJ(K)                                                        C  78
      YJ(I)=YJ(K)                                                        C  79
      XJ(K)=TEMP                                                         C  80
      YJ(K)=TEMS                                                         C  81
   13 CONTINUE                                                           C  82
      IREX=1                                                             C  83
   14 IF (NF-NS) 19,15,15                                                C  84
   15 DO 18 J=MREG,MF                                                    C  85
      DO 17 I=NS,NF                                                      C  86
      IF (XO(J)-XI(I)) 16,16,17                                          C  87
   16 NUMB(I)=NUMB(I)+1                                                  C  88
      GO TO 18                                                           C  89
   17 CONTINUE                                                           C  90
      NUMB(NFP)=NUMB(NFP)+1                                              C  91
   18 CONTINUE                                                           C  92
      GO TO 20                                                           C  93
   19 NUMB(NFP)=M                                                        C  94
   20 M=0                                                                C  95
      DO 24 L=NS,NFP                                                     C  96
      IF (NUMB(L)) 24,24,21                                              C  97
   21 M=NUMB(L)                                                          C  98
      NSTA=L-NUST                                                        C  99
      GO TO 35                                                           C 100
   22 IF (INSC) 24,23,24                                                 C 101
   23 MSTA=MSTA+M                                                        C 102
   24 CONTINUE                                                           C 103
   25 K=MSTA-MREG                                                        C 104
      IF (IREV) 28,23,26                                                 C 105
   26 M2F=K/2+MREG-1                                                     C 106
      DO 27 I=MREG,M2F                                                   C 107
      J=MF+MREG-I                                                        C 108
      TEMP=XO(I)                                                         C 109
      TEMS=YO(I)                                                         C 110
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```
      XO(I)=XO(J)                                                       C 111
      YO(I)=YO(J)                                                       C 112
      XO(J)=TEMP                                                        C 113
      YO(J)=TEMS                                                        C 114
27    CONTINUE                                                          C 115
28    IF (IREV) 31,31,29                                                C 116
29    DO 30 I=1,N2                                                      C 117
      J=N-1-2                                                           C 118
      J=N+1-I                                                           C 119
      TEMP=XJ(I)                                                        C 110
      TEMS=YJ(I)                                                        C 120
      XJ(I)=XJ(J)                                                       C 121
      YJ(I)=YJ(J)                                                       C 122
      XJ(J)=TEMP                                                        C 123
      YJ(J)=TEMS                                                        C 124
30    CONTINUE                                                          C 125
31    RETURN                                                            C 126
32    WRITE (6,51)                                                      C 127
      INSC=1                                                            C 128
      GO TO 25                                                          C 129
33    H=(XMAX-XMIN)/FLOATF(NO-NW-NREG)                                  C 130
      WRITE (6,52) H                                                    C 131
      INSC=1                                                            C 132
      GO TO 25                                                          C 133
34    WRITE (6,53) L                                                    C 134
      GO TO 25                                                          C 135
35    NCON=1                                                            C 136
      REFA=1.414214                                                     C 137
      NFIN=NSTA+NUSED-1                                                 C 138
      DO 36 I=NSTA,NFIN                                                 C 139
      XI(I)=XJ(I)                                                       C 140
      YI(I)=YJ(I)                                                       C 141
36    CONTINUE                                                          C 142
      NSTA1=NSTA+1                                                      C 143
      XSCALF=(XI(NFIN)-XI(NSTA))/10.                                    C 144
      YMAX=YI(NSTA)                                                     C 145
      YMIN=YI(NSTA)                                                     C 146
      DO 37 I=NSTA1,NFIN                                                C 147
      YMAX=AMAX1(YMAX,YI(I))                                            C 148
      YMIN=AMIN1(YMIN,YI(I))                                            C 149
37    CONTINUE                                                          C 150
      YSCALF=YMAX-YMIN                                                  C 151
      DO 38 I=NSTA,NFIN                                                 C 152
      XI(I)=XI(I)/XSCALF                                                C 153
      YI(I)=(YI(I)-YMIN)/YSCALF+.5                                      C 154
38    CONTINUE                                                          C 155
      XH=ABSF(XM)/XSCALF                                                C 156
      NFIN=NSTA+N-1                                                     C 157
      NTA=NSTA                                                          C 158
39    EPSIL=.01*XH                                                      C 159
      DO 44 II=NTA,NFIN                                                 C 160
      XO(II)=XO(II)/XSCALF                                              C 161
      YO(II)=0.0                                                        C 162
      RNUM=1.0                                                          C 163
      DO 44 I=NSTA,NFIN                                                 C 164
```

```
C       FIND XO(III)-XI(I) FOR NUMERATOR AND CHECK FOR NEARNESS.                C 165
        XNUM=XO(III)-XI(I)                                                      C 166
        IF (ABSF(XNUM)-EPSIL) 40,40,41                                          C 167
40      YO(III)=YI(I)                                                           C 168
        GO TO 45                                                                C 169
C       PNUM = PRODUCT OF ALL XNUM                                              C 170
41      PNUM=PNUM*XNUM                                                          C 171
C       CONSTRUCT DENOMINATOR AND SUM                                           C 172
        PDEN=1.0                                                                C 173
        DO 43 J=NSTA,NFIN                                                       C 174
        IF (I-J) 42,43,42                                                       C 175
42      PDEN=(XI(I)-XI(J))*PDEN                                                 C 176
        IF QUOTIENT OVERFLOW 47,43                                              C 177
43      CONTINUE                                                                C 178
        DEN=PDEN*XNUM                                                           C 179
        YO(III)=YI(I)/DEN+YO(III)                                               C 180
        IF ACCUMULATOR OVERFLOW 50,44                                           C 181
44      CONTINUE                                                                C 182
        YO(III)=YO(III)*PNUM                                                    C 183
45      YO(III)=(YO(III)-.5)*YSCALE+YMIN                                        C 184
        XO(III)=XO(III)*XSCALE                                                  C 185
46      CONTINUE                                                                C 186
        INSC=0                                                                  C 187
        GO TO 22                                                                C 188
47      WRITE (6,54) NCON,XSCALE                                                C 189
        WRITE (6,55) II,I,J                                                     C 190
        NCON=NCON+1                                                             C 191
        DO 48 I=NSTA,NFIN                                                       C 192
        XI(I)=XI(I)/REEA                                                        C 193
48      CONTINUE                                                                C 194
        XO(III)=XO(III)*XSCALE                                                  C 195
        MTA=II                                                                  C 196
        XH=XH/REEA                                                              C 197
        XSCALE=XSCALE*REEA                                                      C 198
        IF (NCON-8) 39,39,49                                                    C 199
49      INSC=1                                                                  C 200
        GO TO 22                                                                C 201
50      WRITE (6,56)                                                            C 202
        INSC=1                                                                  C 203
        GO TO 22                                                                C 204
C                                                                               C 205
51      FORMAT (44HC ERROR IN INPUT TO NTRPSR.  N IS NEGATIVE. )                C 206
52      FORMAT (58HC ERROR IN INPUT TO NTRPSR.  MINIMUM ALLOWABLE SPACING       C 207
       1IS 1PE12.3)                                                             C 208
53      FORMAT (43H0 INTRP WAS UNABLE TO INTERPOLATE IN RANGE I3)               C 209
54      FORMAT (8H  NCON =I3,11H, XSCALE = F10.7)                               C 210
55      FORMAT (26H  OVERFLOW OCCURRED AT II=I4,4H  I=I3,4H  J=I3)              C 211
56      FORMAT (48HC ACCUMULATOR OVERFLOW.  DEN MUST BE TOO SMALL. )            C 212
        END                                                                     C 213-
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```
      SUBROUTINE DGUNC (XG,DENQ,NGAS,TEMPI)                                 D    1
C     DGUNC   FINDS G(V) - G(V-X)                                           D    2
      DIMENSION XG(20), DENQ(20)                                            D    3
      DIMENSION UEV(3000), EV(3000), BV(200), BI(3000), TEMP(200), U(200    D    4
     1), Y(200), Z(200)                                                     D    5
      COMMON Y,TEMP,UEV,EV,Q,NST,N,MST,M,XMIN,XMAX,INSC,MBEG,NUST,BI,NI,    D    6
     1NS,MAXIT,FACM,ZNU,DE,WE,WEXE,WEYE,WEZE,WETE,BE,ALPHAE,GAMMAE,DELTA    D    7
     2E,VNIN,BQ,MQ,SDEP,U,BV,Z,ICK,N,K,HDES,EPSLNE                          D    8
      V=TEMPI                                                               D    9
      VA=V*V                                                                D   10
      VB=VA*V                                                               D   11
      VC=VB*V                                                               D   12
      DO 1 I=1,NGAS                                                         D   13
      Y=TEMPI-XG(I)                                                         D   14
      X=Y                                                                   D   15
      XA=X*X                                                                D   16
      XB=XA*X                                                               D   17
      XC=XB*X                                                               D   18
      DENQ(I)=WE*X+(XA-2.*V*X)*WEXE+((VA*X-V*XA)*3.+XB)*WEYE+((VB*X+V*XB    D   19
     1)*4.-6.*VA*XA-XC)*WEZE+((VC*X-V*XC)*5.+(VA*XB-VB*XA)*10.)*WETE        D   20
1     CONTINUE                                                              D   21
      RETURN                                                                D   22
      END                                                                   D   23-
```

APPENDIX II

COMPUTER PROGRAM FRANKON

The program FRANKON was used at AFWL to calculate Franck-Condon factors, r centroids, r^2 centroids. A listing of this program is included in this appendix along with an explanation of the input data and a sample data deck.

1. INPUT DATA

The reduced mass of the molecule or the mass of each atom is needed. These can be based on either C_{12} or O_{16}. A good source for reduced masses based on O_{16} is Herzberg (Ref. 31). The vibrational potential of the lower electronic state and the vibrational potential of the upper electronic state is read into the program. The value of the internuclear separation r and the potential v(r) may be read in any one of several different units. The potential to be read in can be obtained from the output of program TURNGPT or it can be taken from potentials which have been published. There is also the option of generating an analytic potential by programming the desired expressions and putting these in subroutine POTGEN.

Also needed are the dissociation energies of the upper and lower electronic states and the energies of the various vibrational levels for which one wishes to calculate Franck-Condon factors. The Franck-Condon factors can be calculated for any desired rotational level by specifying appropriate values for JROTL, JROTU. The energies of the rotationless vibrational levels are then adjusted by adding the appropriate rotational energy given by

$$E_R = \left\{Be + \alpha_e(v+\tfrac{1}{2}) + \gamma_e(v+\tfrac{1}{2})^2\right\} \frac{J(J+1)}{\left(\frac{h\, N_o\, \mu}{8\pi^2\, c\, a_o^2}\right)}$$

where the constants Be, α_e, γ_e are read in for the lower and upper states. The separation of the minimums of the two states, Te, is also read in.

2. DATA DECK

As in the case of program TURNGPT, Zare has made extensive use of comment cards in program FRANKON and little or no explanation is needed to explain how to set up the data deck.

Card Number

1	ITEST I1	1 in column one if problem is to follow
2	Title 72H1	carriage control in column 1, name of problem in columns 1-72
3	IIMS, ZMAS1, ZMAS2, I4, 2F10.0	IIMS = 1 mass based on C = 12 IIMS = 2 mass based on O = 16 ZMAS1 mass of first atom (reduced mass of molecule) ZMAS2 mass of second atom (or zero when using reduced mass)
(for lower state)		
4	IIRA, IIEN, N(IKON) 3I4	IIRA = units used for internuclear separation IIRA = 1 atomic units (a_o) IIRA = 2 Angstrom units (Å) IIEN = units used for energy IIEN = 1 atomic units (hartree) IIEN = 2 1/cm (kayser) IIEN = 3 electron volt N(IKON) = number of data points for potential to be read in
5 through 5+N(1)	XI, YI Format in columns 13-72 of Card 4	XI - internuclear separation in units at IIRA YI - energy of corresponding point of potential in units of IIEN

Card Number		
6+N(1)	NDE, DE(IKON) I4, F10.0	NDE = 0 if zero point of the potential is at R = ∞ NDE = 1 if zero point of the potential is at R = R_e
7+N(1)	XMIN, XMAX, XH, IIRA 3F100, I4	XMIN, XMAX the minimum and maximum value of internuclear separation at which the wave functions were calculated, with mesh spacing of XH all in units of IIRA
8+N(1)	NL, IIEN, NET 3I4 Formats for next card	NL - number of expected energy levels with units of IIEN NET = 0 zero of potential at R = ∞ NET = 1 zero of potential at R = R_e
9+N(1)	KV(I,IKON), ETRIAL (I,IKON)	KV - the vibrational level ETRIAL - energy of the vibrational level KV(IKON) in number
(for upper state)		
10+N(1)	IIRA, IIEN, N(IKON) same	Same as for lower state
11+N(1) through 11+N(1)+N(2)	XI, YI	Potential for upper state; same description as lower state N(2) in number
12+N(1) +N(2)	NDE, DE(IKON) Same	Same as for lower state
13+N(1) +N(2)	XMIN, XMAX, XH, IIRAI	Same as for lower state
14+N(1) +N(2)	NL (IKON) IIEN1, NET	Same as for lower state
15+N(1) +N(2)	KV (I, IKON) ETRIAL (I, IKON)	Same as for lower state
16+N(1) +N(2)	NI, NS, IPSIQ, MAXIT, EPS 4I4, E10.0	NI - 1 prints iterations, otherwise not

Card Number		
Card 16 (cont'd)		NS = 1 prints wavefunctions every IPSIQ points NS = 33 prints eigenvalues and node count MAXIT - maximum number of times SCHR will try and satisfy convergence criterion EPS - convergence criterion
17+N(1) +N(2)	JROTL, JROTU 2I3	lower and upper rotational levels respectively
18+N(1) +N(2)	BE1, AE1, GE1, BE2, AE2, GE2 6E10.3	rotational constants for lower and upper states
19+N(1) +N(2)	TE E10.3	TE - relative difference in energy (units of 1/cm) of the lower and upper states
20+N(1) +N(2)	NPOT I3	potential printed every NPOT points
21+N(1) +N(2)	Blank	

```
      PROGRAM FRANCK(INPUT,OUTPUT,PLOT)                                  A   1
C     FRANCK CALCULATES VIBRATIONAL TRANSITION PROBABILITIES FOR         A   2
C     DIATOMIC MOLECULES.  IT IS BASED ON A PROGRAM OBTAINED FROM J.     A   3
C     ZARE.  THE POINTS DEFINING THE POTENTIAL ARE READ INTO THE PROGRAM  A   4
C     A SPLINE FIT IS USED TO INTERPOLATE FROM THESE TO THE INTEGRATION   A   5
C     GRID.  THE INNER BRANCH OF THE POTENTIAL IS THEN EXTRAPOLATED BY A  A   6
C     FUNCTION OF THE FORM A/R**E(R).  THE OUTER BRANCH IS EXTRAPOLATED   A   7
C     BY A FUNCTION OF THE FORM DE-A/R**E(R).  THE SO DEFINED POTENTIAL   A   8
C     IS USED IN THE SCHRODINGER EQUATION WHICH IS SOLVED BY SUBROUTINE   A   9
C     SCHRO.  THE WAVEFUNCTIONS ARE INTEGRATED BY MEANS OF A SIMPSONS     A  10
C     RULE SCHEME IN THE OVERLAP INTEGRAL.                               A  11
C                                                                        A  12
C        N=NUMBER OF POINTS DEFINING THE POTENTIAL.MUST BE 60 OR LESS    A  13
C        NL=NUMBER OF LEVELS .MUST BE 30 OR LESS                         A  14
C                                                                        A  15
      COMMON XI(6 ),X1(62),XO(10000),V(10000),S(10000),ETOTAL(30),QIBA(3 A  16
     1),QIEN(3),QIMS(2),ZIMS(2),ZIBA(2),ZIEN(3),ECALC(30),XBRN(5),DVE(30 A  17
     2),VBRN(5),QTERM(10),QUEMT(10),BVE(30),RESULT(30,30),RCNTRD(30,30)  A  18
     3,RRCN(30,30),PRRCN(30,30),PRRRN(30,30),KV(30),N(2),NL(2),DE(2),RRE A  19
     4MT(10),RRET(10),DIV(50),SUMRR(30),SUMR(30),TITLE(8),XH,MSTA,MSTA,M A  20
     5,XMIN,XMAX,IREC,MREC,MUSED,NI,NS,MAXIT,EACH,ZMU,IKON,ERS,IRSID,SCH A  21
     6R,SU(10000)                                                       A  22
      DIMENSION XSTATE(2)                                               A  23
C                                                                       A  24
C      THE FOLLOWING COMMENT CARDS DESCRIBE THE PREPARATION OF DATA.    A  25
C                                                                       A  26
C      FIRST CARD IN DATA HAS A ONE IN COLUMN 1 IF A PROBLEM FOLLOWS.   A  27
C      VERY LAST CARD IN DATA MUST BE A BLANK CARD.....                 A  28
C                                                                       A  29
C       INITIALIZING PLOT ROUTINE...                                    A  30
C                                                                       A  31
C      NEXT  CARD IN DATA HAS NAME OF PROBLEM IN COLUMNS 1-72. WHERE    A  32
C      CARRIAGE CONTROL IS IN COLUMN 1.  SECOND CARD HAS TIME AND       A  33
C      MASSES OF THE TWO ATOMS.                                         A  34
C     IF ZMAS2 = 0. ZMAS1 IS TAKEN AS THE REDUCED MASS IN THE TIME UNITS A  35
C      TIME = 1. MASS UNITS ARE BASED ON C12 = 12.                      A  36
C      TIME = 2. MASS UNITS ARE BASED ON O16 = 16.                      A  37
C                                                                       A  38
C     LIMIT ON N(IKON) IS 60 . ON NL(IKON) IS 30 VIBRATIONAL LEVELS     A  39
    1 READ 76, ITEST                                                    A  40
      IF (ITEST) 2,75,2                                                 A  41
C     ICKTP - CHECK TO DETERMINE WHETHER WAVEFUNCTIONS WILL BE CALCULATE A  42
C     FD OR READ FROM TAPE 1.  ICKTP=0 FD CALCULATION  ICKTP=1 READ FROM A  43
C     TAPE                                                              A  44
    2 READ 78, TITLE                                                    A  45
      READ 76, ICKTP                                                    A  46
C     STATE(1) - IS THE LOWER STATE. STATE(2) - IS THE UPPER STATE      A  47
      READ 77, XSTATE(1)                                                A  48
      READ 77, XSTATE(2)                                                A  49
      READ 79, TIME,ZMAS1,ZMAS2                                         A  50
C                                                                       A  51
C       SET-UP FOR PLOTTING POTENTIALS...                               A  52
C       END OF PLOT SET-UP                                              A  53
C                                                                       A  54
C      NEXT DATA CARD CONTAINS XMIN,XMAX,YH,IRA. WHERE IRA GIVES THE    A  55
```

```
C      UNITS FOR THE MIN AND MAX DISTANCES AND THE SPACING XH.                  A  56
C                                                                               A  57
       READ 80, XMINTE,XMAXTE,XHTE,IIRA1                                        A  58
C                                                                               A  59
C      NEXT TWO CARDS ARE THE VALUES OF J FOR THE LOWER AND UPPER STATE         A  60
C                                                                               A  61
       READ 81, JPOTL,JPOTU                                                     A  62
C                                                                               A  63
C      NEXT CARD IN DATA HAS IIRA, IIEN, AND THE NUMBER OF POINTS, EACH         A  64
C      IN I4 FORMAT, AS WELL AS THE FORMAT STATEMENT WHICH CONTROLS THE         A  65
C      READING OF THE POINTS (IN COLUMNS 13-72)--FOR EXAMPLE- (4F16.8).        A  66
C      IIEN = 1, ENERGY IS IN ATOMIC UNITS.  ( 1 A.U. = 27.1961 E.V.)           A  67
C      IIEN = 2, ENERGY IS IN 1/CM.                                             A  68
C      IIEN = 3, ENERGY IS IN ELECTRON VOLTS.  ( 1 E.V. = 8065.68 1/CM)         A  69
C      IIRA = 1, DISTANCE IS IN ATOMIC UNITS.  ( 1 A.U. = .529166 ANG.)         A  70
C      IIRA = 2, DISTANCE IS IN ANGSTROMS.                                      A  71
C      FOLLOWING CARDS CONTAIN THE INPUT POTENTIAL POINTS.                      A  72
C      IF IT IS DESIRED TO USE A FUNCTION TO GENERATE THE WHOLE                 A  73
C      POTENTIAL CURVE, THE FIRST 12 COLUMNS OF THE IIRA, ETC. CARD             A  74
C      MUST BE BLANK.  A HOLLERITH TEXT MUST BE PUNCHED IN 13-72, AS            A  75
C      IT WILL BE PRINTED.  THE NEXT CARD IN SUCH A CASE CONTAINS               A  76
C      XMIN,XMAX,ETC.                                                           A  77
C                                                                               A  78
C        UPPER STATE IS READ IN FIRST, LOWER STATE LAST                         A  79
C      THE SAME VALUE OF IIEN,IIRA,NDE,XH,XMIN,XMAX,IIRA1,NET                   A  80
C      ,IIEN1 MUST BE USED FOR BOTH THE GROUND AND UPPER STATE                  A  81
       IKON=2                                                                   A  82
3      READ 82, IIRA,IIEN,N(IKON),(DTERMT(I),I=1,10)                            A  83
       XMIN=XMINTE                                                              A  84
       XMAX=XMAXTE                                                              A  85
       XH=XHTE                                                                  A  86
       NIKON=N(IKON)                                                            A  87
C      READ DTERMT,(XI(I),YI(I),I=1,NIKON)                                      A  88
       NDO=N(IKON)/2                                                            A  89
       NZP=NDO+1                                                                A  90
       READ DTERMT, XI(NZP),YI(NZP),DDO,DDO1                                    A  91
       I1=I1=NZP                                                                A  92
       DO 4 I=1,NDO                                                             A  93
       I1=I1-1                                                                  A  94
       I1=I1+1                                                                  A  95
       READ DTERMT, XI(I1),YI(I1),YI(I1),YI(I1)                                 A  96
       YI(I1)=YI(I1)                                                            A  97
4      CONTINUE                                                                 A  98
C                                                                               A  99
C      NEXT CARD CONTAINS NDE AND THE DISSOCIATION ENERGY WHERE NDE IS          A 100
C      ZERO IF ZERO PT OF POTENTIAL CURVE IS AT R=INFINITY, OR ONE IF AT        A 101
C      R=REQUILIBRIUM.  DISSOCIATION ENERGY HAS SAME UNITS AS POTENTIAL.        A 102
C                                                                               A 103
       READ 83, NDE,DE(IKON)                                                    A 104
C                                                                               A 105
C      NEXT CARD HAS NO. AND IIEN OF EXPECTED ENERGY LEVELS, AND NET            A 106
C      WHICH HAS THE SAME INTERPRETATION FOR ETRIAL(I) AS NDE DOES FOR          A 107
C      THE POTENTIAL CURVE ABOVE.                                               A 108
C      IT ALSO CONTAINS THE VARIABLE FORMAT FOR READING ENERGY LEVELS           A 109
C                                                                               A 110
```

```
      READ 84, NL(IKON),IIEN1,NET,(DUENT(I),I=1,10)                    A 111
      NLIKON=NL(IKON)                                                  A 112
C                                                                      A 113
C     READ IN ENERGY LEVELS                                            A 114
C                                                                      A 115
      READ DUENT, (EV(I),EIRIAL(I),I=1,NLIKON)                         A 116
C                                                                      A 117
C        READ IN THE EXPERIMENTAL RV  , CALLED RVE                     A 118
      READ 85, (RVE(I),I=1,NLIKON)                                     A 119
C                                                                      A 120
C     DOING FIRST FOR THE UPPER STATE AND THEN THE LOWER STATE,SCHRODING A 121
C     ERS EQUATION USING THE FOLLOWING METHOD                          A 122
C     D2 NU SCHR MODIFIED FOR THE 709/7090/7094 IS DESCRIBED  IN       A 123
C     B. N. ZARE AND J. K. CASHION, UCRL-10881, 1963                   A 124
C     FOR THIS PROGRAM THE CONSTANTS ARE USED AS FOLLOWS               A 125
C     IF NI = 1, PRINTS ITERATIONS, OTHERWISE NOT                      A 126
C     IF NS = 1, PRINTS WAVEFUNCTION EVERY IRSIO POINTS, OTHERWISE NOT A 127
C     IF NS = 33, PRINTS EIGENVALUES AND NODE COUNT                    A 128
C     EPS IS THE CONVERGENCE CRITERION                                 A 129
C     EPS IS IN THE SAME UNITS AS THE POTENTIAL CURVE                  A 130
C     MAXIT IS THE MAXIMUM NUMBER OF TIMES SCHR WILL TRY TO SATISFY THE A 131
C     CONVERGENCE CRITERION                                            A 132
C                                                                      A 133
      LLIM=100                                                         A 134
      KLIM=2                                                           A 135
      READ 86, NI,NS,IRSIO,MAXIT,EPS                                  A 136
C                                                                      A 137
C     NEXT CARD CONTAINS NPOT,                                         A 138
C     THE POTENTIAL IS PRINTED AT EVERY NPOT POINT,                    A 139
C     NPOT = 50 IS SUGGESTED TO THE USER,                              A 140
C                                                                      A 141
      READ 81, NPOT                                                    A 142
C                                                                      A 143
C     THIS TERMINATES COMMENT CARDS ON THE PREPARATION OF DATA,        A 144
C     IF NO FURTHER PROBLEMS FOLLOW, REMEMBER TO ADD A BLANK CARD TO THE A 145
C     DATA DECK                                                        A 146
C                                                                      A 147
C                                                                      A 148
      QIPA(1)=6HA.U.                                                   A 149
      QIPA(2)=6HANGST.                                                 A 150
      QIEN(1)=6HA.U.                                                   A 151
      QIEN(2)=6HCM-1                                                   A 152
      QIEN(3)=6HE.V.                                                   A 153
      QIMS(1)=6HC)2=12                                                 A 154
      QIMS(2)=6HO)6=16                                                 A 155
C                                                                      A 156
C     OUTPUT IS IN WAVE NUMBERS AND ANGSTROMS                          A 157
C      PRINT HEADING                                                   A 158
C                                                                      A 159
      PRINT 79, TITLE                                                  A 160
C                                                                      A 161
      PRINT 81, JPOTI,JPOTU                                            A 162
C      PRINT THE MASSES AND THEIR UNITS,                               A 163
C                                                                      A 164
      IF (ZMASS) 6,6,5                                                 A 165
```

```
5       PRINT 87, QIMS(IIMS),ZMAS1,ZMAS2                                A 166
        GO TO 7                                                         A 167
6       PRINT 88, QIMS(IIMS),ZMAS1                                      A 168
7       CONTINUE                                                        A 169
C                                                                       A 170
C       PRINT THE INPUT POTENTIAL, THE DISSOCIATION ENERGY, AND UNITS.  A 171
C       IF READ IN.                                                     A 172
C                                                                       A 173
        PRINT 89, QIPA(IIPA),QIEN(IIEN)                                 A 174
        NIKON=N(IKON)                                                   A 175
        PRINT 90, (XI(I),YI(I),I=1,NIKON)                               A 176
        PRINT 91, DE(IKON)                                              A 177
        PRINT 92, XMIN,XMAX,XH,QIPA(IIPA1)                              A 178
C                                                                       A 179
C       PRINT THE TRIAL ENERGY LEVELS AND THEIR UNITS.                  A 180
C                                                                       A 181
        PRINT 93, QIEN(IIEN1),(KV(I),ETRIAL(I),I=1,NLIKON)              A 182
C                                                                       A 183
C       PRINT THE CONVERGENCE CRITERION.                                A 184
C                                                                       A 185
        PRINT 94, EPS,QIEN(IIEN)                                        A 186
C                                                                       A 187
C       PRINT HEADING                                                   A 188
        PRINT 78, TITLE                                                 A 189
C         PLOTTING GENERATED POTENTIALS...                              A 190
C                                                                       A 191
        IF (ZMAS2) 8,8,9                                                A 192
8       ZMU=ZMAS1                                                       A 193
        GO TO 10                                                        A 194
9       ZMU=ZMAS1*ZMAS2/(ZMAS1+ZMAS2)                                   A 195
10      ZIMS(1)=1.0                                                     A 196
        ZIMS(2)=.0006784                                                A 197
        ZIRA(1)=1.0                                                     A 198
        ZIRA(2)=1.889766                                                A 199
        ZMU=ZMU*ZIMS(IIMS)                                              A 200
        ZIEN(1)=ZMU*3.64366*E3                                          A 201
        ZIEN(2)=ZMU*1.6610826E-2                                        A 202
        ZIEN(3)=ZMU*1.3287766E2                                         A 203
        FACM=60.201702/ZMU                                              A 204
        N2=N(2)                                                         A 205
        NL2=NL(2)                                                       A 206
        IND=N(IKON)                                                     A 207
        DO 11 I=1,IND                                                   A 208
        YI(I)=YI(I)*ZIEN(IIEN)                                          A 209
        XI(I)=XI(I)*ZIRA(IIRA)                                          A 210
11      CONTINUE                                                        A 211
        DE=DE*ZIEN(IIEN)                                                A 212
        DE(2)=DE(2)*ZIEN(IIEN)                                          A 213
        XMIN=XMIN*ZIRA(IIRA1)                                           A 214
        XMAX=XMAX*ZIRA(IIRA1)                                           A 215
        XH=XH*ZIRA(IIRA1)                                               A 216
        EPS=EPS*ZIEN(IIEN)                                              A 217
        INDL=NL(IKON)                                                   A 218
        DO 12 I=1,INDL                                                  A 219
        ETRIAL(I)=ETRIAL(I)*ZIEN(IIEN1)                                 A 220
```

```
12    CONTINUE                                                          A 221
      CALL POTFIT                                                       A 222
C      CHECK FOR RESCALING OF POTENTIAL TO ZERO AT R=INFINITY           A 223
      IF (NDF) 74,15,13                                                 A 224
13    DO 14 I=1,M                                                       A 225
      V(I)=V(I)-DE(IKON)                                                A 226
14    CONTINUE                                                          A 227
15    IF (NFT) 71,18,16                                                 A 228
16    DO 17 I=1,INDL                                                    A 229
      ETRIAL(I)=ETRIAL(I)-DE(IKON)                                      A 230
17    CONTINUE                                                          A 231
18    DO 19 I=1,INDL                                                    A 232
      ECALC(I)=ETRIAL(I)                                                A 233
19    CONTINUE                                                          A 234
C                                                                       A 235
C      PRINT THE POTENTIAL CURVE GENERATED (ANGSTROMS AND 1/CM)         A 236
C     272 WRITE(1),ISTATE,IKON,M                                        A 237
C     BUFFER OUT(1,1)(XO(1),XO(M))                                      A 238
C     135 CONTINUE                                                      A 239
C     IF(UNIT,1)135,240,240,240                                         A 240
C     240 BUFFER OUT(1,1)(V(1),V(M))                                    A 241
      PRINT 95                                                          A 242
      NPOT4=NPOT*4                                                      A 243
      NPOT5=NPOT*5                                                      A 244
      DO 26 I=1,M,NPOT5                                                 A 245
      IF (M-I-NPOT4) 20,21,21                                           A 246
20    JFIN=(M-I)/NPOT                                                   A 247
      IF (JFIN) 27,27,22                                                A 248
21    JFIN=5                                                            A 249
22    DO 23 J=1,JFIN                                                    A 250
      IPRN=I+NPOT*(J-1)                                                 A 251
      XPRN(J)=XO(IPRN)*.529166                                          A 252
      VPRN(J)=(V(IPRN)+DE(IKON))*FACM                                   A 253
23    CONTINUE                                                          A 254
      IF (VPRN(1)-1.E6) 25,24,24                                        A 255
24    PRINT 96, (XPRN(J),VPRN(J),J=1,JFIN),IPRN                         A 256
      GO TO 26                                                          A 257
25    PRINT 97, (XPRN(J),VPRN(J),J=1,JFIN),IPRN                         A 258
26    CONTINUE                                                          A 259
27    MTEMO=M                                                           A 260
      LLK=0                                                             A 261
      KLK=0                                                             A 262
C      FIND THE ENERGY LEVELS THROUGH USE OF SCHR.                      A 263
      DO 40 I=1,NLIKON                                                  A 264
      CALL SCHRO (KV(I),ECALC(I))                                       A 265
      IF (SCHR-1.) 29,28,71                                             A 266
28    LLK=LLK+1                                                         A 267
      IF (LLK-LLIM) 29,29,73                                            A 268
29    M=MTEMO                                                           A 269
      DO 30 J=1,M                                                       A 270
30    XO(J)=(J-1)*XH+XMIN                                               A 271
      RVSUM=S(1)**2/XO(1)**2+4.*S(2)**2/XO(2)**2+S(M)**2/XO(M)**2       A 272
      KSIMP=M-1                                                         A 273
      DO 31 J=3,KSIMP,2                                                 A 274
      RVSUM=2.*S(J)**2/XO(J)**2+4.*S(J+1)**2/XO(J+1)**2+RVSUM           A 275
```

```
31    CONTINUE                                                          A 276
C     ALSO WRITE WAVEFUNCTION ONTO TAPE                                 A 277
C     WRITE(1)IKON,NLIKON,I,M                                           A 278
C     IKON-POTENTIAL,NLIKON-NUMBER OF VIBRATIONAL LEVELS FOR            A 279
C     POTENTIAL IKON,I-NUMBER OF THE LEVEL,M-NUMBER OF POINTS AT WHICH  A 280
C     WAVEFUNCTION IS TABULATED                                         A 281
C     BUFFER OUT (1,1)(S(1),S(M))                                       A 282
      GO TO (33,32), IKON                                               A 283
C     PUT WAVEFUNCTION INTO EXTENDED CORE FOR LATER USE                 A 284
32    INEC=1+(I-1)*M                                                    A 285
      CALL WRITEC (S(1),INEC,M)                                         A 286
      GO TO 39                                                          A 287
33    DO 38 IK=1,NL2                                                    A 288
      INEC=1+M*(IK-1)                                                   A 289
      CALL READEC (SU(1),INEC,M)                                        A 290
      DO 34 J=1,M                                                       A 291
      XO(J)=(FLOATF(J-1)*XH+XMIN)*SU(J)                                 A 292
34    CONTINUE                                                          A 293
      CALL SIMP (S,SU,M,XH,RESULT(I,IK))                                A 294
      CALL SIMP (S,XO,M,XH,RCNTRD(I,IK))                                A 295
      A=XMIN                                                            A 296
      DO 35 J=1,M                                                       A 297
      XO(J)=A*XO(J)                                                     A 298
      A=A+XH                                                            A 299
35    CONTINUE                                                          A 300
      CALL SIMP (S,XO,M,XH,RRCN(I,IK))                                  A 301
      A=XMIN                                                            A 302
      DO 36 J=1,M                                                       A 303
      XO(J)=A*XO(J)                                                     A 304
      A=A+XH                                                            A 305
36    CONTINUE                                                          A 306
      CALL SIMP (S,XO,M,XH,RRRCN(I,IK))                                 A 307
      A=XMIN                                                            A 308
      DO 37 J=1,M                                                       A 309
      XO(J)=A*XO(J)                                                     A 310
      A=A+XH                                                            A 311
37    CONTINUE                                                          A 312
      CALL SIMP (S,XO,M,XH,RRRRN(I,IK))                                 A 313
38    CONTINUE                                                          A 314
39    RVE(I)=FACM*RVSIM*XH/3.                                           A 315
      ECALC(I)=DE(IKON)*FACM+ECALC(I)                                   A 316
      PRINT 99, ECALC(I),RVE(I)                                         A 317
40    CONTINUE                                                          A 318
      PRINT 79, TITLE                                                   A 319
      PRINT 99, LLK                                                     A 320
      PRINT 100, XSTATE(IKON)                                           A 321
      PRINT 101                                                         A 322
      DO 43 I=1,NLIKON                                                  A 323
      ETRIAL(I)=(ETRIAL(I)+DE(IKON))*FACM                               A 324
      DIFF=ECALC(I)-ETRIAL(I)                                           A 325
      IF (I-1) 42,42,41                                                 A 326
41    DGT=ETRIAL(I)-ETRIAL(I-1)                                         A 327
      DGC=ECALC(I)-ECALC(I-1)                                           A 328
      DIFDF=DGC-DGT                                                     A 329
      PRINT 102, DGT,DGC,DIFDF                                          A 330
```

```
42    PRINT 103, KV(I),FTRIAL(I),FCALC(I),DIFF                    A 331
43    CONTINUE                                                    A 332
      PRINT 104, XSTATE(IKON)                                     A 333
      PRINT 105                                                   A 334
      DO 44 I=1,NLIKON                                            A 335
      PRINT 106, KV(I),PVF(I),PVE(I)                              A 336
44    CONTINUE                                                    A 337
      GO TO (46,45), IKON                                         A 338
45    IKON=1                                                      A 339
      GO TO 3                                                     A 340
46    CONTINUE                                                    A 341
      DO 47 J=1,NL                                                A 342
      DO 47 IK=1,NL2                                              A 343
      RES=RESULT(J,IK)                                            A 344
      R=0.529166                                                  A 345
      RCNTRD(J,IK)=RCNTRD(J,IK)*R/RES                             A 346
      R=R*0.529166                                                A 347
      RRCN(J,IK)=RRCN(J,IK)*R/RES                                 A 348
      R=R*0.529166                                                A 349
      RRRCN(J,IK)=RRRCN(J,IK)*R/RES                               A 350
      R=R*0.529166                                                A 351
      RRRRN(J,IK)=RRRRN(J,IK)*R/RES                               A 352
      RESULT(J,IK)=RES*RES                                        A 353
47    CONTINUE                                                    A 354
      PRINT 107, TITLE                                            A 355
      NL1S=1$NL1F=10                                              A 356
48    CONTINUE                                                    A 357
      PRINT 109, (KV(J),J=NL1S,NL1F)                              A 358
      DO 49 J=1,NL2                                               A 359
      K=J-1                                                       A 360
      PRINT 108, K,(RESULT(ILK,J),ILK=NL1S,NL1F)                  A 361
      IF (MOD(J,5).NE.0) GO TO 49                                 A 362
      PRINT 114                                                   A 363
49    CONTINUE                                                    A 364
      PRINT 115                                                   A 365
      IF (NL1F.GE.NL) GO TO 50                                    A 366
      NL1S=NL1F+1$NL1F=NL1S+9                                     A 367
      IF (NL1F.LT.NL) GO TO 48                                    A 368
      NL1F=NL$GOTO27                                              A 369
50    CONTINUE                                                    A 370
C       SUMMING ECF                                               A 371
      DO 51 J=1,NL                                                A 372
      DO 51 JJ=1,NL2                                              A 373
51    SUMPP(J)=SUMPP(J)+RESULT(J,JJ)                              A 374
      DO 52 JJ=1,NL2                                              A 375
      DO 52 J=1,NL                                                A 376
52    SUMP(JJ)=SUMP(JJ)+RESULT(J,JJ)                              A 377
      PRINT 70, TITLE                                             A 378
      DO 53 J=1,NL                                                A 379
      JM1=J-1                                                     A 380
      PRINT 110, JM1,SUMPP(J)                                     A 381
53    SUMPP(J)=0.                                                 A 382
      DO 54 JJ=1,NL2                                              A 383
      JJM1=JJ-1                                                   A 384
      PRINT 111, JJM1,SUMP(JJ)                                    A 385
```

```
54    SUMR(JJ)=0.                                                    A 386
      PRINT 112, TITLE                                               A 387
      NL1S=1$NL1F=14                                                 A 388
55    CONTINUE                                                       A 389
      PRINT 127, (KV(J),J=NL1S,NL1F)                                 A 390
      DO 56 J=1,NL2                                                  A 391
      K=J-1                                                          A 392
      PRINT 113, K,(RCNTRD(ILK,J),ILK=NL1S,NL1F)                     A 393
      IF (MOD(J,5).NE.0) GO TO 56                                    A 394
      PRINT 114                                                      A 395
56    CONTINUE                                                       A 396
      PRINT 115                                                      A 397
      IF (NL1F.GE.NL) GO TO 57                                       A 398
      NL1S=NL1F+1$NL1F=NL1S+13                                       A 399
      IF (NL1F.LT.NL) GO TO 55                                       A 400
      NL1F=NL$GOTO6001                                               A 401
57    CONTINUE                                                       A 402
      PRINT 116, TITLE                                               A 403
      NL1S=1$NL1F=14                                                 A 404
58    CONTINUE                                                       A 405
      PRINT 127, (KV(J),J=NL1S,NL1F)                                 A 406
      DO 59 J=1,NL2                                                  A 407
      K=J-1                                                          A 408
      PRINT 113, K,(PRCN(ILK,J),ILK=NL1S,NL1F)                       A 409
      IF (MOD(J,5).NE.0) GO TO 59                                    A 410
      PRINT 114                                                      A 411
59    CONTINUE                                                       A 412
      PRINT 115                                                      A 413
      IF (NL1F.GE.NL) GO TO 60                                       A 414
      NL1S=NL1F+1$NL1F=NL1S+13                                       A 415
      IF (NL1F.LT.NL) GO TO 58                                       A 416
      NL1F=NL$GOTO6002                                               A 417
60    CONTINUE                                                       A 418
      PRINT 117, TITLE                                               A 419
      NL1S=1$NL1F=14                                                 A 420
61    CONTINUE                                                       A 421
      PRINT 127, (KV(J),J=NL1S,NL1F)                                 A 422
      DO 62 J=1,NL2                                                  A 423
      K=J-1                                                          A 424
      PRINT 113, K,(PRRCN(ILK,J),ILK=NL1S,NL1F)                      A 425
      IF (MOD(J,5).NE.0) GO TO 62                                    A 426
      PRINT 114                                                      A 427
62    CONTINUE                                                       A 428
      PRINT 115                                                      A 429
      IF (NL1F.GE.NL) GO TO 63                                       A 430
      NL1S=NL1F+1$NL1F=NL1S+13                                       A 431
      IF (NL1F.LT.NL) GO TO 61                                       A 432
      NL1F=NL$GOTO551                                                A 433
63    CONTINUE                                                       A 434
      PRINT 118, TITLE                                               A 435
      NL1S=1$NL1F=14                                                 A 436
64    CONTINUE                                                       A 437
      PRINT 127, (KV(J),J=NL1S,NL1F)                                 A 438
      DO 65 J=1,NL2                                                  A 439
      K=J-1                                                          A 440
```

```
      PRINT 113, K,(PRRPN(ILK,J),ILK=NL1S,NL1F)                          A 441
      IF (MOD(J,5).NE.0) GO TO 65                                        A 442
      PRINT 114                                                          A 443
65    CONTINUE                                                           A 444
      PRINT 115                                                          A 445
      IF (NL1F.GE.NL) GO TO 66                                           A 446
      NL1S=NL1F+1$NL1F=NL1S+13                                           A 447
      IF (NL1F.LT.NL) GO TO 64                                           A 448
      NL1F=NL$GOTO655                                                    A 449
66    CONTINUE                                                           A 450
      PUNCH 119, TITLE                                                   A 451
      PUNCH 121, NL2,NL                                                  A 452
      PUNCH 120                                                          A 453
      PUNCH 122, (((I,J,RESULT(J,I),J=1,NL),I=1,NL2)                     A 454
      PUNCH 123                                                          A 455
      PUNCH 124, (((I,J,RCNTRD(J,I),J=1,NL),I=1,NL2)                     A 456
      PUNCH 125                                                          A 457
      PUNCH 124, (((I,J,RRCN(J,I),J=1,NL),I=1,NL2)                       A 458
      PUNCH 126                                                          A 459
      PUNCH 124, (((I,J,RRRCN(J,I),J=1,NL),I=1,NL2)                      A 460
      DO 67 IK=1,NL2                                                     A 461
      DO 67 J=1,NL                                                       A 462
      RESULT(J,IK)=RCNTRD(J,IK)/RRCN(J,IK)                               A 463
      RCNTRD(J,IK)=RRCN(J,IK)/RRRCN(J,IK)                                A 464
      RRCN(J,IK)=RRRCN(J,IK)/RRRPN(J,IK)                                 A 465
67    CONTINUE                                                           A 466
      PRINT 128, TITLE                                                   A 467
      NL1S=1$NL1F=14                                                     A 468
68    CONTINUE                                                           A 469
      PRINT 127, (KV(J),J=NL1S,NL1F)                                     A 470
      DO 69 J=1,NL2                                                      A 471
      K=J-1                                                              A 472
      PRINT 129, (RESULT(J,ILK),ILK=NL1S,NL1F)                           A 473
      PRINT 130, K,(RCNTRD(J,ILK),ILK=NL1S,NL1F)                         A 474
      PRINT 131, (RRCN(J,ILK),ILK=NL1S,NL1F)                             A 475
      IF (MOD(J,5).NE.0) GO TO 69                                        A 476
      PRINT 114                                                          A 477
69    CONTINUE                                                           A 478
      PRINT 115                                                          A 479
      IF (NL1F.GE.NL) GO TO 70                                           A 480
      NL1S=NL1F+1$NL1F=NL1S+13                                           A 481
      IF (NL1F.LT.NL) GO TO 68                                           A 482
      NL1F=NL$GOTO691                                                    A 483
70    CONTINUE                                                           A 484
      GO TO 1                                                            A 485
71    KLK=KLK+1                                                          A 486
      IF (KLK-KLIM) 20,72,72                                             A 487
72    PRINT 132, KLIM                                                    A 488
      GO TO 1                                                            A 489
73    PRINT 133, LLIM,I                                                  A 490
      GO TO 1                                                            A 491
74    PRINT 6, NOF                                                       A 492
      GO TO 1                                                            A 493
75    CALL EXIT                                                          A 494
C                                                                        A 495
```

```
 76    FORMAT (I1)                                                          A 496
 77    FORMAT (A10)                                                         A 497
 78    FORMAT (8A10)                                                        A 498
 79    FORMAT (I4,2F10.0)                                                   A 499
 80    FORMAT (3F10.0,I4)                                                   A 500
 81    FORMAT (2I3)                                                         A 501
 82    FORMAT (3I4,10A6)                                                    A 502
 83    FORMAT (I4,F10.0)                                                    A 503
 84    FORMAT (3I4,10A6)                                                    A 504
 85    FORMAT (8F10.0)                                                      A 505
 86    FORMAT (4I4,F10.0)                                                   A 506
 87    FORMAT (////40H  THE MASSES OF THE TWO ATOMS, BASED ON A6,6H, ARE F  A 507
     110.6,5H AND F10.6///)                                                 A 508
 88    FORMAT (///46H  THE REDUCED MASS OF THE TWO ATOMS, BASED ON A6,5H,   A 509
     1 IS F10.6///)                                                         A 510
 89    FORMAT (35H  THE INPUT POTENTIAL POINTS, R IN A6,15H AND ENERGY IN   A 511
     1 A6,18HARE GIVEN BELOW,  //1X,5(6X,1HR,10X,1HV,4X)//)                 A 512
 90    FORMAT (1XF10.6,F12.4,F10.6,F12.4,F10.6,F12.4,F10.6,F12.4,F10.6,F1   A 513
     12.4)                                                                  A 514
 91    FORMAT (47HO DISSOCIATION ENERGY IN SAME UNITS AS ABOVE ISE20.8)     A 515
 92    FORMAT (////9H  RMIN = F10.7,9H, RMAX = F10.7,12H, SPACING = F10.7   A 516
     1,9H, ALL IN A6)                                                       A 517
 93    FORMAT (////20H  THE TRIAL ENERGY LEVELS IN A6,16HARE GIVEN BELOW,   A 518
     1//1X,5(5HLEVEL,3X,6HENERGY,6X)//(1H I4,1PF16.7,I4,F16.7I4,F16.7,I4   A 519
     2,F16.7,I4,F16.7))                                                     A 520
 94    FORMAT (////43H  CONVERGENCE CRITERION IS ERROR LESS THAN E9.2,2XA    A 521
     14)                                                                    A 522
 95    FORMAT (37HO THE POTENTIAL FUNCTION GENERATED IS///1X,5(3X,4HR(A),   A 523
     14X,7HV(1/CM),2X))                                                     A 524
 96    FORMAT (1X0PF10.6,1PF12.5,4(0PF10.6,1PF12.5),4XI5)                   A 525
 97    FORMAT (1XF10.6,F12.4,F10.6,F12.4,F10.6,F12.4,F10.6,F12.4,F10.6,F1   A 526
     12.4,4XI5)                                                             A 527
 98    FORMAT (30HO SCHR FINDS ENERGY LEVEL G = F11.5,15H 1/CM AND BV = F   A 528
     111.7,5H 1/CM)                                                         A 529
 99    FORMAT (38HO PROGRAM SUCCESSFUL,  (MAXIT REACHED I2,7H TIMES))       A 530
100    FORMAT (23HO THE BELOW IS FOR THE A10,6H STATE)                      A 531
101    FORMAT (54HOVIB, NO,   GIVEN ENERGY  CALC, ENERGY      DIFFERENCE)  A 532
     13X,43HGIVEN DELTA G  CALC, DELTA G      DIFFERENCE/44X,26HDIFFERENC   A 533
     2E = CALC, - GIVEN//)                                                  A 534
102    FORMAT (64X3E15.5)                                                   A 535
103    FORMAT (I8,3E15.5)                                                   A 536
104    FORMAT (29H1 THE BELOW IS FOR THE STATE A10)                         A 537
105    FORMAT (1HO28X,8HVIB, NO.,3X,9HCALC,  BV5X,8HEXP, BV ///)            A 538
106    FORMAT (28X17,3E15.8)                                                A 539
107    FORMAT (28H1 FRANCK CONDN FACTORS FOR ,8A10)                         A 540
108    FORMAT (I3,1X,10(2X,F10.3))                                          A 541
109    FORMAT (1H ,2X,4HV',=,4X,10(I2,10X)/1X,2HV,/)                        A 542
110    FORMAT (29H THE SUM OVER ALL V- FOR V--=,I3,2HIS,F12.8)              A 543
111    FORMAT (29H THE SUM OVER ALL V-- FOR V-=,I3,2HIS,F12.8)              A 544
112    FORMAT (37H1 R CENTROID FACTORS (ANGSTROMS) FOR ,8A10)               A 545
113    FORMAT (I4,14(3X,F6.4))                                              A 546
114    FORMAT (1H )                                                         A 547
115    FORMAT (1H ////)                                                     A 548
116    FORMAT (29H1 R**2 CENTROIDS FOR ,8A10)                               A 549
117    FORMAT (29H1 R**3 CENTROIDS FOR ,8A10)                               A 550
```

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  118   FORMAT (19H1 R**4 CENTROID FOR,8A10)                                  A 551
  119   FORMAT (8A10)                                                         A 552
  120   FORMAT (23H FRANCK CONDON FACTORS )                                   A 553
  121   FORMAT (2I3)                                                          A 554
  122   FORMAT (4(2I3,2X,F12.5))                                              A 555
  123   FORMAT (13H R CENTROIDS )                                             A 556
  124   FORMAT (6(1X,2I2,F8.4))                                               A 557
  125   FORMAT (16H R**2 CENTROIDS )                                          A 558
  126   FORMAT (16H R**3 CENTROIDS )                                          A 559
  127   FORMAT (1H0,3X,3HVV=,3X,14(I2,7X)/2X,1HV/)                            A 560
  128   FORMAT (24H1 RATIO OF CENTROIDS FOR,8A10)                             A 561
  129   FORMAT (1H,4X,14(3X,F6.4))                                            A 562
  130   FORMAT (1H ,I2,4X,14(3X,F6.4))                                        A 563
  131   FORMAT (1H,8X,14(3X,F6.4))                                            A 564
  132   FORMAT (26H0 SCHR NOT SUCCESSFUL FOR I2,28HTH TIME, GO TO NEXT PRO    A 565
       1BLEM.)                                                              A 566
  133   FORMAT (28H0 SCHR DID NOT CONVERGE FOR I2,17HTH TIME WHEN I = I3)     A 567
        END                                                                 A 568-
```

```
      SUBROUTINE POTFIT                                                 B   1
      COMMON XI(60),YI(60),XO(10000),V(10000),S(10000),ETRIAL(30),OIRA(2 B   2
     1),OIEN(3),OIMS(2),ZIMS(2),ZIRA(2),ZIEN(3),FCALC(30),XPRN(5),BVE(30 B   3
     2),VPRN(5),DTERMT(10),DUEMT(10),BVE(30),RESULT(30,30),RCNTRD(30,30) B   4
     3,RRCN(30,30),RBRCN(30,30),RRRRN(30,30),KV(30),N(2),NL(2),DE(2),PRF B   5
     4MT(10),PNET(19),DIV(50),SUMPP(30),SUMP(30),TITLE(8),XH,NSTA,MSTA,M B   6
     5,XMIN,XMAX,INSC,MREG,MUSED,NI,NS,MAXIT,FACM,ZMU,IKON,EPS,IPSIQ,SCH B   7
     6R,SU(10000)                                                       B   8
      DIMENSION Z(60), AX(60), BX(60), CX(60), DX(60)                   B   9
      XMAXT=XMAX                                                        B  10
      XMINT=XMIN                                                        B  11
C      CHECK FOR EXTRAPOLATION AT SMALL R.                              B  12
      IF (XMIN-XI(1)) 1,2,2                                             B  13
1     XMAX=XI(1)                                                        B  14
      INSC=1                                                            B  15
      NLL=N(IKON)                                                       B  16
      CALL XTRAP (XI,YI,NLL,XO,V,M,XH,XMIN,XMAX,INSC,FACM,MREG,DE(IKON)) B  17
      MT=M                                                              B  18
      XMIN=XO(MT)+XH                                                    B  19
      MREG=M+1                                                          B  20
C      PREPARE TO INTERPOLATE.                                          B  21
2     M=0                                                               B  22
      XMAX=XMAXT                                                        B  23
      IF (XMAX-XI(NLL)) 4,4,3                                           B  24
3     XMAX=XI(NLL)                                                      B  25
4     CALL SPLXYZ (XI,YI,Z,NLL,AX,BX,CX,DX)                             B  26
      MEND=MREG+INT((XMAX-XMIN)/XH)                                     B  27
      XOO=XMIN                                                          B  28
      DO 5 II=MREG,MEND                                                 B  29
      CALL SPNXYZ (XI,YI,Z,NLL,XOO,VO)                                  B  30
      V(II)=VO                                                          B  31
      XO(II)=XOO                                                        B  32
5     XOO=XOO+XH                                                        B  33
C      CHECK FOR EXTRAPOLATION AT LARGE R.                              B  34
      IF (XMAXT-XMAX) 7,7,6                                             B  35
6     MREG=MEND+1                                                       B  36
      XMIN=XO(MREG-1)+XH                                                B  37
      XMAX=XMAXT                                                        B  38
      INSC=2                                                            B  39
      CALL XTRAP (XI,YI,NLL,XO,V,M,XH,XMIN,XMAX,INSC,FACM,MREG,DE(IKON)) B  40
      INSC=0                                                            B  41
7     XMIN=XMINT                                                        B  42
      M=M+MREG-1                                                        B  43
      RETURN                                                            B  44
      END                                                               B  45
```

```
      SUBROUTINE SPLXYZ (X,Y,Z,N,A,B,C,DX)                                C    1
      DIMENSION X(1), Y(1), Z(1)                                          C    2
      DIMENSION A(1), B(1), C(1), DX(1)                                   C    3
      DATA D6/.01715525252525252552/                                      C    4
      DATA D3/.01716525252525252552/                                      C    5
      NP=N-1                                                              C    6
      NQ=N-2                                                              C    7
      DO 2 K=1,NP                                                         C    8
      DX(K)=X(K+1)-X(K)                                                   C    9
      IF (DX(K)) 1,1,2                                                    C   10
1     PRINT 6, X(K),X(K+1),DX(K),K                                        C   11
      STOP 301                                                            C   12
2     CONTINUE                                                            C   13
      A(1)=-DX(1)                                                         C   14
      C(1)=-1./DX(2)                                                      C   15
      B(1)=1./DX(1)-C(1)                                                  C   16
      Z(1)=0.                                                             C   17
      DYX=(Y(2)-Y(1))/DX(1)                                               C   18
      DO 3 K=2,NP                                                         C   19
      KK=K-1                                                              C   20
      A(K)=DX(KK)*D6                                                      C   21
      B(K)=(DX(K)+DX(KK))*D3                                              C   22
      C(K)=DX(K)*D6                                                       C   23
      DYXP=DYX                                                            C   24
      DYX=(Y(K+1)-Y(K))/DX(K)                                             C   25
      Z(K)=DYX-DYXP                                                       C   26
3     CONTINUE                                                            C   27
      AA=-1./DX(NQ)                                                       C   28
      CC=-1./DX(NP)                                                       C   29
      BB=-(AA+CC)                                                         C   30
      A(N)=AA*B(NP)-A(NP)*BB                                              C   31
      B(N)=AA*C(NP)-A(NP)*CC                                              C   32
      Z(N)=AA*Z(NP)                                                       C   33
      XF=A(2)*A(1)                                                        C   34
      B(2)=B(2)-XF*B(1)                                                   C   35
      C(2)=C(2)-XF*C(1)                                                   C   36
      DO 4 K=2,NP                                                         C   37
      KK=K+1                                                              C   38
      XF=A(KK)/B(K)                                                       C   39
      B(KK)=B(KK)-XF*C(K)                                                 C   40
      Z(KK)=Z(KK)-XF*Z(K)                                                 C   41
4     CONTINUE                                                            C   42
      Z(N)=Z(N)/B(N)                                                      C   43
      DO 5 K=1,NQ                                                         C   44
      KK=N-K                                                              C   45
      Z(KK)=(Z(KK)-Z(KK+1)*C(KK))/B(KK)                                   C   46
5     CONTINUE                                                            C   47
      Z(1)=-(Z(2)*B(1)+Z(3)*C(1))*A(1)                                    C   48
      RETURN                                                              C   49
C                                                                         C   50
6     FORMAT (1H1,1X,3E25.15,I15)                                         C   51
      END                                                                 C   52-
```

```
      SUBROUTINE SPNXYZ (X,Y,Z,N,UX,UY)                                  D    1
      DIMENSION X(1), Y(1), Z(1)                                         D    2
      DATA X6A/0.1756252626262626262626/                                 D    3
      IF (UX-X(1)) 1,2,3                                                 D    4
1     PRINT 13, UX,X(1),X(N),N                                           D    5
      STOP 311                                                           D    6
2     UY=Y(1)                                                            D    7
      RETURN                                                             D    8
3     IF (UX-X(N)) 5,4,1                                                 D    9
4     UY=Y(N)                                                            D   10
      RETURN                                                             D   11
5     SH=N                                                               D   12
      SL=1.                                                              D   13
6     I=(SH+SL)*.5                                                       D   14
      IF (UX-X(I)) 7,11,10                                               D   15
7     SH=I                                                               D   16
8     IF (SH-SL-1.) 9,12,6                                               D   17
9     STOP 312                                                           D   18
10    SL=I                                                               D   19
      GO TO 8                                                            D   20
11    UY=Y(I)                                                            D   21
      RETURN                                                             D   22
12    M=SL                                                               D   23
      MA=SH                                                              D   24
      XA=X(MA)-X(M)                                                      D   25
      XAA=XA*XA                                                          D   26
      XAB=1./XA                                                          D   27
      XB=X(MA)-UX                                                        D   28
      XBA=XB*XB                                                          D   29
      XBB=XB*(XBA-XAA)                                                   D   30
      XC=UX-X(M)                                                         D   31
      XCA=XC*XC                                                          D   32
      XCC=XC*(XCA-XAA)                                                   D   33
      UY=((Z(M)*XBB+Z(MA)*XCC)*X6A+(Y(MA)*XC+Y(M)*XB))*XAB               D   34
      RETURN                                                             D   35
C                                                                        D   36
13    FORMAT (1H1,1X,3E25.15,I15)                                        D   37
      END                                                                D   38-
```

```
      SUBROUTINE XTRAP (XI,YI,N,XO,V,M,XH,XMIN,XMAX,INSC,FACM,MREG,DF)     F    1
      DIMENSION XI(1), YI(1), XO(1), V(1), EN(2), XL(6), YL(6), SIGH(1),   F    2
     1 ANS(4)                                                              F    3
C     V=C1*P**(A*LOG(P)+B)                                                  F    4
      PF(X)=C1*X**(A*ALOG(X)+B)                                            F    5
      DF1(X)=DF-PF(X)                                                      F    6
      IF (INSC.GT.1) GO TO 2                                               F    7
C      INITIALIZING SECTION FOR INNER BRANCH OF POTENTIAL                  F    8
      M=XFIXF((XMAX-XMIN)/XH)+1                                            F    9
      MP=1                                                                 F   10
      IST=1                                                                F   11
      IFIN=M                                                               F   12
C       LEAST SQUARES PARAMETERS                                           F   13
      ILS=1$ILF=6                                                          F   14
      DO 1 I=ILS,ILF                                                       F   15
      XL(I)=ALOG(XI(I))                                                    F   16
1     YL(I)=ALOG(YI(I))                                                    F   17
      MPTS=6$NORDER=2$NINT=1                                               F   18
      SIGH(1)=XL(MPTS)                                                     F   19
      CALL LSQRT (XL,YL,NINT,NORDER,MPTS,SIGH,ANS)                         F   20
      A=0.                                                                 F   21
      B=ANS(2)                                                             F   22
      GO TO 4                                                              F   23
C      INITIALIZING SECTION FOR OUTER BRANCH OF POTENTIAL                  F   24
2     M=XFIXF((XMAX-XMIN)/XH)+1                                            F   25
      IFIN=MREG+M-1                                                        F   26
      IST=MREG                                                             F   27
      MP=N                                                                 F   28
C     SET UP LEAST SQUARES PARAMETERS                                      F   29
      ILS=N-5$ILF=N                                                        F   30
C     FINDING A, B  BY LEAST SQUARES METHOD FROM LAST 6 POINTS OF POTENT   F   31
      J=1                                                                  F   32
      DO 3 I=ILS,ILF                                                       F   33
      XL(J)=ALOG(XI(I))                                                    F   34
      YL(J)=ALOG(YI(I))                                                    F   35
3     J=J+1                                                                F   36
      MPTS=6                                                               F   37
      NORDER=2                                                             F   38
      NINT=1                                                               F   39
      SIGH(1)=XL(MPTS)                                                     F   40
      CALL LSQRT (XL,YL,NINT,NORDER,MPTS,SIGH,ANS)                         F   41
      A=0.                                                                 F   42
      B=-ANS(2)                                                            F   43
C      C=ANS(1) BUT NOT USED                                               F   44
4     CONTINUE                                                             F   45
      D1P=A*ALOG(XI(MP)*.529166)+B                                         F   46
      D1=A*ALOG(XI(MP))+B                                                  F   47
      IF (INSC.GT.1) GO TO 5                                               F   48
      C1=YI(MP)/XI(MP)**D1                                                 F   49
      GO TO 6                                                              F   50
5     C1=(DF-YI(MP))/XI(MP)**D1                                            F   51
6     CONTINUE                                                             F   52
      DO 9 I=IST,IFIN                                                      F   53
      XO(I)=FLOATF(I-IST)*XH+XMIN                                          F   54
      IF (INSC.GT.1) GO TO 7                                               F   55
```

```
      V(I)=PE(XO(I))                                                    E  56
      GO TO 8                                                           E  57
7     V(I)=PE1(XO(I))                                                   E  58
8     CONTINUE                                                          E  59
9     CONTINUE                                                          E  60
C      PRINT VARIABLE                                                   E  61
      C1=C1*EACM*.529166**D1P                                           E  62
      EN(2)=5HRIGHT                                                     E  63
      EN(1)=5HLEFT                                                      E  64
      PRINT 10, EN(IMSC)                                                E  65
      PRINT 11, A,B,C1,D1P                                              E  66
      RETURN                                                            E  67
C                                                                       E  68
10    FORMAT (////40H THE PARAMETERS USED TO EXTRAPOLATE THE AS,46H BRANC  E  69
     1H OF THE POTENTIAL CURVE ARE AS FOLLOWS /)                        E  70
11    FORMAT (3H A=E10.3,3H B=E10.3,4H C1=E10.3,4H D1=E10.3,32H WHERE V=  E  71
     1C1*X**D1, D1=A*LOG(Y)+B//)                                        E  72
      END                                                               E  73-
```

```
      SUBROUTINE SCHRO (KV,E0)                                          F    1
C     NOTE  COMMON NAMES HAVE BEEN CHANGED TO MAKE BLOCK COMPATABLE     F    2
C     WITH THIS SUBROUTINE                                              F    3
      COMMON XI(60),YI(60),XO(10000),V(10000),S(10000),ETRIAL(30),OIRA(2 F    4
     1),OIEN(3),OIMS(2),ZIMS(2),ZIRA(2),ZIEN(3),ECALC(30),XPRN(5),BVE(30 F    5
     2),VPRN(5),DIFRMT(10),DUFMT(10),BVF(30),RESULT(30,30),RCNTRD(30,30) F    6
     3,RRCN(30,30),RRRCN(30,30),RRRRN(30,30),TV(30),L(2),NN(2),DD(2),PRE F    7
     4MT(10),PNET(10),DIV(50),SUMPP(30),SUMP(30),TITLE(8),XH,NSTA,MSTA,N F    8
     5,XMIN,XMAX,INSC,MREG,MUSED,NI,NS,MAXIT,FACM,ZMU,IKON,EPS,IPSIQ,SCH F    9
     6P,SU(10000)                                                       F   10
      DIMENSION Y(3), P(10000)                                          F   11
      EQUIVALENCE (P,XO), (XMIN,RMIN), (XMAX,RMAX)                      F   12
C     SCHRV   PRINTS EVERY 'IPSIQ'TH POINT OF THE WAVE FUNCTIONS.       F   13
C     RADIAL SOLUTION TO SCHRODINGER EQUATION SUBROUTINE                F   14
C      USE UNITS SUCH THAT SCHR EQN IS-PSI2 + (E-V)PSI = 0              F   15
C     NI=1, PRINT ITERATIONS                                            F   16
C     NI=OTHERWISE, DONT PRINT                                          F   17
C     NS=1, PRINT SOLUTIONS WITH EACH ENERGY LEVEL                      F   18
C     NS=33, PRINT ENERGY LEVELS ONLY                                   F   19
C     NS=OTHERWISE, DONT PRINT                                          F   20
      IF (NI-1) 2,1,2                                                   F   21
1     EPRIN=E0*FACM                                                     F   22
      PRINT 42, KV,EPRIN                                                F   23
      PRINT 43                                                          F   24
2     CONTINUE                                                          F   25
      H=(RMAX-RMIN)/FLOAT(N-1)                                          F   26
      H2=H**2                                                           F   27
      HV=H2/12.                                                         F   28
      E=E0                                                              F   29
      TEST=-1.                                                          F   30
      DE=0.                                                             F   31
C                                                                       F   32
C     START ITER LOOP                                                   F   33
C                                                                       F   34
      DO 22 IT=1,MAXIT                                                  F   35
C     .....START INWARD INTEGRATION                                     F   36
      P(N)=1.E-30                                                       F   37
      GN=V(N)-E                                                         F   38
      GI=V(N-1)-E                                                       F   39
C     .....TEST IF E TOO HIGH                                           F   40
      IF (GI) 3,4,4                                                     F   41
3     PRINT 44                                                          F   42
      SCHR=2.                                                           F   43
      GO TO 41                                                          F   44
4     P(N-1)=P(N)*EXPF(RMAX*SQRTF(GN)-(RMAX-H)*SQRTF(GI))               F   45
      Y=(1.-HV*GN)*P(N)                                                 F   46
      Y(2)=(1.-HV*GI)*P(N-1)                                            F   47
C     .....INTEGRATE                                                    F   48
      M=N-2                                                             F   49
5     Y(3)=Y(2)+(Y(2)-Y)+H2*GI*P(M+1)                                   F   50
      GI=V(M)-E                                                         F   51
      P(M)=Y(3)/(1.-HV*GI)                                              F   52
C     .....OVERFLOW                                                     F   53
      M1=M+1                                                            F   54
      PM=P(M1)                                                          F   55
```

```
      DO 6 J=M1,M                                                       F  56
6     P(J)=P(J)/DM                                                      F  57
      V=V/DM                                                            F  58
      Y(2)=Y(2)/DM                                                      F  59
      Y(3)=Y(3)/DM                                                      F  60
      GI=V(M+1)-E                                                       F  61
      GO TO 5                                                           F  62
C     *****TEST FOR CROSSING PT.                                        F  63
      IF (ABSF(P(M))-ABSF(P(M+1))) 9,9,7                                F  64
7     IF (M-2) 9,9,8                                                    F  65
8     V=Y(2)                                                            F  66
      Y(2)=Y(3)                                                         F  67
      M=M-1                                                             F  68
      GO TO 5                                                           F  69
C                                                                       F  70
9     DM=P(M)                                                           F  71
      MSAVE=M                                                           F  72
      VIN=Y(2)/DM                                                       F  73
      DO 10 J=M,N                                                       F  74
10    P(J)=P(J)/DM                                                      F  75
C                                                                       F  76
C     *****START OUTWARD INTEGRATION                                    F  77
C                                                                       F  78
      P(1)=1.E-20                                                       F  79
      V=0.                                                              F  80
      GI=V-E                                                            F  81
      Y(2)=(1.-HV*GI)*P                                                 F  82
      DO 13 I=2,M                                                       F  83
11    Y(3)=Y(2)+((Y(2)-V)+H2*GI*P(I-1))                                 F  84
      GI=V(I)-E                                                         F  85
      P(I)=Y(3)/(1.-HV*GI)                                              F  86
      II=I-1                                                            F  87
      DM=P(II)                                                          F  88
      DO 12 J=1,II                                                      F  89
12    P(J)=P(J)/DM                                                      F  90
      V=V/DM                                                            F  91
      Y(2)=Y(2)/DM                                                      F  92
      Y(3)=Y(3)/DM                                                      F  93
      GI=V(II)-E                                                        F  94
      GO TO 11                                                          F  95
C                                                                       F  96
      V=Y(2)                                                            F  97
13    Y(2)=Y(3)                                                         F  98
C                                                                       F  99
C     *****FINISHED OUTWARD INTEGRATION                                 F 100
      DM=P(M)                                                           F 101
      IF (DM) 14,17,14                                                  F 102
14    VOUT=Y/DM                                                         F 103
      VM=Y(3)/DM                                                        F 104
      DO 15 J=1,M                                                       F 105
15    P(J)=P(J)/DM                                                      F 106
C                                                                       F 107
C     *****CORRECTION                                                   F 108
C                                                                       F 109
      DE=0.                                                             F 110
```

```
      DO 16 J=1,N                                                       F 111
16    DF=DF-P(J)**2                                                     F 112
      F=(-YOUT-YIN+2.*YM)/H2+(V(M)-F)                                   F 113
      DOLD=DF                                                           F 114
17    F=9.999999E+29                                                    F 115
      DF=-F                                                             F 116
      DF=ABSF(.0001*F)                                                  F 117
      GO TO 18                                                          F 118
      DF=-F/DF                                                          F 119
18    IF (NI-1) 20,19,20                                                F 120
19    ERRIN=F*FACM                                                      F 121
      DERRIN=DF*FACM                                                    F 122
      PRINT 45, IT,ERRIN,F,DF,DERRIN,MSAVE                              F 123
20    FOLD=F                                                            F 124
      F=F+DF                                                            F 125
      TEST=MAX1F(ABSF(DOLD)-ABSF(DF),TEST)                              F 126
      IF (TEST) 22,21,21                                                F 127
21    IF (ABSF(F-FOLD)-ABSF(EPS)) 23,23,22                              F 128
22    CONTINUE                                                          F 129
      SCHR=1.                                                           F 130
      GO TO 24                                                          F 131
C     .....CONVERGED-COUNT NODES                                        F 132
23    SCHR=0.                                                           F 133
24    KV=0                                                              F 134
      NL=N-2                                                            F 135
      DO 34 J=2,NL                                                      F 136
      IF (P(J)) 26,25,25                                                F 137
25    IF (P(J-1)) 27,34,34                                              F 138
26    IF (P(J-1)) 34,31,29                                              F 139
C     POS. NODE                                                         F 140
27    IF (P(J+1)) 34,28,28                                              F 141
28    IF (P(J-2)) 33,34,34                                              F 142
C     NEG. NODE                                                         F 143
29    IF (P(J+1)) 30,34,34                                              F 144
30    IF (P(J-2)) 34,33,33                                              F 145
C     FALSE NODE DUE TO UNDERFLOW                                       F 146
31    IF (P(J+1)) 32,34,34                                              F 147
32    IF (P(J-2)) 34,34,33                                              F 148
33    KV=KV+1                                                           F 149
34    CONTINUE                                                          F 150
C     .....NORMALIZE                                                    F 151
      SN=SQRTF(-H*DF)                                                   F 152
      DO 35 J=1,N                                                       F 153
35    C(J)=P(J)/SN                                                      F 154
C     .....PRINT SOLUTION                                               F 155
      F=F*FACM                                                          F 156
      IF (NS-1) 38,36,38                                                F 157
36    IPSIA=IPSIO*300                                                   F 158
      IPSIB=IPSIO*40                                                    F 159
      IPSIC=IPSIO*25                                                    F 160
      IPSID=IPSIO*50                                                    F 161
      DO 37 JF=1,N,IPSIA                                                F 162
      PRINT 46, KV,M                                                    F 163
      PRINT 46, KV,F                                                    F 163
      JL=MINOF(JF+IPSIB,N)                                              F 164
```

```
      DO 37 J=JF,JL,IPSIO                                                F 165
      IL=XMINOF(J+IPSIO,N)                                               F 166
      PRINT 47, (I,S(I),I=J,IL,IPSIO)                                    F 167
37    CONTINUE                                                           F 168
38    F0=F                                                               F 169
      IF (NS-33) 40,39,40                                                F 170
39    PRINT 48, XV,F                                                     F 171
40    CONTINUE                                                           F 172
41    RETURN                                                             F 173
C                                                                        F 174
42    FORMAT (47H1SCHR- SOLUTION OF RADIAL SCHR. EQUATION FOR V=I3,5X,7H  F 175
42    FORMAT (47H1SCHR- SOLUTION OF RADIAL SCHR. EQUATION FOR V=I3,5X,7H  F 176
     1ETRIAL=1PE15.7,9H    (1/CM))                                       F 176
43    FORMAT (20H0 ITER          F                F(F)              DF(F)  F 177
     1       D(F)     )                                                  F 178
44    FORMAT (50H DIFFERENCE EQUATION SOLUTION TECHNIQUE FAILS      )    F 179
45    FORMAT (1H0I4,2X,1P4E16.7,5X,29H THE CROSSING PT. OCCURS AT  I4)   F 180
46    FORMAT (47H1SCHR- SOLUTION OF RADIAL SCHR. EQUATION FOR V=I3,7H    F 181
     1  E=1PE15.7/20H0    I        S(I)     8(20H     I        S(I)     )) F 182
47    FORMAT (6(I5,1PE15.7))                                             F 183
48    FORMAT (50H0 SOLUTION OF RADIAL SCHRODINGER FOLUATION FOR V = I3,7H F 184
     1   E = 1PE15.7)                                                    F 185
      END                                                                F 186-
```

```
      SUBROUTINE SIMP (S,SS,N,H,RESULT)                                 G    1
C     INTEGRATION OF A PRODUCT S*SSBY SIMPSONS RULE.                    G    2
      DIMENSION S(2000), SS(2000)                                       G    3
      SUM=0.0                                                           G    4
      DO 1 J=2,N,2                                                      G    5
1     SUM=SUM+2.0*S(J)*SS(J)+4.0*S(J-1)*SS(J-1)                         G    6
      RESULT=SUM*H/3.0                                                  G    7
      RETURN                                                            G    8
      END                                                               G    9
```

TABLE OF R-CENTROIDS

Table 95

R-CENTROIDS FOR (CN ReD (1/2))

JV	0	1	2	3	4	5	6	7	8	9
0	1.2[illegible]-0	1.2[illegible]-0	1.3[illegible]-0	1.3[illegible]-0	1.4[illegible]-0	1.5[illegible]-0	1.5[illegible]-0	1.6[illegible]-0	1.5[illegible]-0	1.2[illegible]-0
1	1.1[illegible]-0	1.2[illegible]-0	1.2[illegible]-0	1.3[illegible]-0	1.3[illegible]-0	1.4[illegible]-0	1.5[illegible]-0	1.6[illegible]-0	1.6[illegible]-0	1.6[illegible]-0
2	1.1[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.2[illegible]-0	1.3[illegible]-0	1.3[illegible]-0	1.4[illegible]-0	1.5[illegible]-0	1.6[illegible]-0	1.7[illegible]-0
3	1.0[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.2[illegible]-0	1.2[illegible]-0	1.3[illegible]-0	1.3[illegible]-0	1.4[illegible]-0	1.5[illegible]-0	1.6[illegible]-0
4	1.0[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.2[illegible]-0	1.2[illegible]-0	1.3[illegible]-0	1.3[illegible]-0	1.3[illegible]-0	1.4[illegible]-0	1.5[illegible]-0
5	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.2[illegible]-0	1.1[illegible]-0	1.3[illegible]-0	1.4[illegible]-0	1.4[illegible]-0
6	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.2[illegible]-0	1.2[illegible]-0	1.3[illegible]-0	1.4[illegible]-0
7	9.9[illegible]-1	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.2[illegible]-0	1.2[illegible]-0	1.3[illegible]-0
8	9.7[illegible]-1	9.9[illegible]-1	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0	5.7[illegible]-1	1.2[illegible]-0	1.2[illegible]-0	1.2[illegible]-0
9	9.5[illegible]-1	9.7[illegible]-1	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.2[illegible]-0	1.3[illegible]-0
10	9.3[illegible]-1	9.5[illegible]-1	9.8[illegible]-1	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.2[illegible]-0
11	9.1[illegible]-1	9.3[illegible]-1	9.6[illegible]-1	9.9[illegible]-1	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0	1.1[illegible]-0	1.1[illegible]-0
12	9.[illegible]1-1	9.2[illegible]-1	9.4[illegible]-1	9.7[illegible]-1	9.9[illegible]-1	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0	1.1[illegible]-0
13	9.0[illegible]7-1	9.1[illegible]-1	9.3[illegible]-1	9.5[illegible]-1	9.7[illegible]-1	9.9[illegible]-1	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0
14	8.9[illegible]6-1	9.0[illegible]4-1	9.1[illegible]5-1	9.3[illegible]7-1	9.6[illegible]3-1	9.8[illegible]2-1	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0	1.1[illegible]-0
15	8.8[illegible]3-1	8.9[illegible]7-1	9.0[illegible]4-1	9.2[illegible]1-1	9.4[illegible]7-1	9.6[illegible]4-1	9.8[illegible]7-1	1.0[illegible]-0	1.0[illegible]-0	1.0[illegible]-0
16	8.7[illegible]-1	8.8[illegible]-1	8.9[illegible]-1	9.0[illegible]-1	9.2[illegible]-1	9.4[illegible]-1	9.7[illegible]-1	9.9[illegible]-1	1.0[illegible]-0	1.0[illegible]-0
17	8.3[illegible]9-1	8.7[illegible]1-1	8.8[illegible]9-1	9.0[illegible]5-1	9.1[illegible]9-1	9.3[illegible]9-1	9.5[illegible]9-1	9.7[illegible]3-1	1.0[illegible]-0	1.0[illegible]-0
18	7.9[illegible]6-1	8.3[illegible]0-1	8.6[illegible]7-1	8.8[illegible]6-1	8.9[illegible]2-1	9.1[illegible]6-1	9.4[illegible]1-1	9.6[illegible]5-1	9.8[illegible]1-1	1.0[illegible]-0

Table 95 (cont'd)

(CN RE) (1/2))

V/	10	11	12	13	14	15	16	17	18
/									
	1.[illegible]	1.237-3	1.7[illegible]3-3	1.[illegible]13-3	1.372-3	1.395-3	1.291-3	1.322-3	1.327-3
1	1.21[illegible]	1.[illegible]9[illegible]-3	1.3[illegible]8-1	1.23[illegible]-3	1.316-3	1.315-3	1.471-3	1.364-3	1.523-3
	1.9[illegible]	1.[illegible]33-3	1.153-1	1.23[illegible]-3	1.242-3	1.223-3	1.325-3	1.315-3	1.332-3
3	1.7[illegible]	1.331-3	1.117-3	9.134-1	1.453-3	9.804-1	1.142-3	1.349-3	1.314-3
4	1.647-3	1.773-3	2.[illegible]23-3	1.022-3	1.279-3	1.429-3	1.251-3	3.166-1	3.175-1
5	1.[illegible]54-3	1.[illegible]55-3	1.741-3	1.935-3	7.741-3	1.325-1	3.[illegible]29-3	1.309-3	1.214-3
6	1.41[illegible]-3	1.[illegible]52-3	1.[illegible]03-1	1.737-3	1.[illegible]65-3	1.742-3	1.541-3	3.702-3	6.693-1
7	1.42[illegible]-3	1.449-3	1.[illegible]69-3	1.671-3	1.[illegible]16-3	2.[illegible]56-3	1.[illegible]00-3	1.[illegible]90-1	1.363-3
8	1.346-3	1.429-3	1.446-3	1.577-3	1.579-3	1.814-3	2.476-3	2.[illegible]51-3	1.694-3
9	1.3[illegible]7-3	1.465-3	1.459-3	1.[illegible]04-3	1.585-3	1.588-3	1.823-3	2.[illegible]39-1	1.955-3
10	1.[illegible]97-3	1.318-3	1.154-3	1.449-3	1.513-3	1.593-3	1.696-3	1.829-3	2.[illegible]55-3
11	1.234-3	1.232-3	1.3[illegible]9-3	1.331-3	1.[illegible]51-3	1.521-3	1.6[illegible]2-3	1.704-3	1.943-3
12	1.149-3	1.[illegible]94-3	1.254-1	1.341-3	1.363-3	1.474-3	1.531-3	1.610-3	1.713-3
13	1.[illegible]84-3	1.2[illegible]6-3	1.230-3	1.274-3	1.356-3	1.[illegible]77-3	1.491-3	1.540-3	1.619-3
14	1.223-3	1.1[illegible]5-3	1.211-1	1.397-3	1.247-3	1.375-3	1.390-3	1.514-3	1.553-3
15	1.121-3	1.[illegible]51-3	1.1[illegible]9-3	1.224-3	1.149-3	1.299-1	1.410-3	1.[illegible]02-3	1.569-3
16	1.[illegible]44-3	1.149-3	1.116-3	1.173-3	1.239-3	1.223-3	1.311-3	1.[illegible]69-1	1.412-3
17	1.[illegible]62-3	1.[illegible]39-3	1.149-1	1.135-3	1.19[illegible]-3	1.262-3	1.247-3	1.325-1	1.227-1
18	1.[illegible]46-3	1.[illegible]71-3	1.112-3	9.951-1	1.153-3	1.262-3	1.326-3	1.263-3	1.343-3

Table 96

R-CENTROIDS FOR (CN RED (3/2))

J \ N	0	1	2	3	4	5	6	7	8	9
0	[illegible]	1.253-0	1.334-0	1.361-0	1.433-0	1.559-0	1.729-0	1.357-0	1.555-0	1.247-0
1	[illegible]	1.221-0	1.201-0	1.313-0	1.372-0	1.443-0	1.550-0	1.646-0	1.437-0	1.390-0
2	[illegible]	1.173-0	1.149-0	1.271-0	1.321-0	1.330-0	1.450-0	1.543-0	1.649-0	1.562-0
3	[illegible]	1.135-0	1.183-0	1.214-0	1.245-0	1.329-0	1.388-0	1.457-0	1.547-0	1.659-0
4	[illegible]	1.1[illegible]1-0	1.143-0	1.205-0	1.225-0	1.313-0	1.338-0	1.396-0	1.405-0	1.553-0
5	[illegible]	1.059-0	1.1[illegible]8-0	1.151-0	1.1[illegible]3-0	1.235-0	1.156-0	1.348-0	1.464-0	1.473-0
6	[illegible]	1.041-0	1.077-0	1.116-0	1.152-0	1.176-0	1.245-0	1.256-0	1.359-0	1.413-0
7	9.921-1	1.017-0	1.047-0	1.094-0	1.124-0	1.130-0	1.193-0	1.257-0	1.292-0	1.373-0
8	9.542-1	9.947-1	1.021-0	1.055-0	1.031-0	1.132-0	1.343-0	1.234-0	1.273-0	1.295-0
9	9.243-1	9.714-1	9.994-1	1.028-	1.052-0	1.093-0	1.143-0	1.139-0	1.214-0	1.306-0
10	8.723-1	9.425-1	9.775-1	1.003-0	1.035-0	1.070-0	1.177-0	1.158-0	1.164-0	1.225-0
11	8.1[illegible]0-1	9.105-1	9.545-1	9.819-1	1.010-0	1.043-0	1.077-0	1.116-0	1.197-0	1.177-0
12	8.1[illegible]6-1	9.591-1	9.257-1	9.617-1	9.971-1	1.017-0	1.059-0	1.035-0	1.126-0	1.061-0
13	8.346-1	8.457-1	8.913-1	9.391-1	9.655-1	9.937-1	1.125-0	1.057-0	1.093-0	1.138-0
14	9.743-1	9.535-1	8.594-1	9.102-1	9.404-1	9.719-1	1.051-0	1.032-0	1.065-0	1.101-0
15	[illegible]	9.490-1	8.444-1	9.749-1	9.233-1	9.516-1	9.783-1	1.039-0	1.039-0	1.073-0
16	[illegible]	9.251-1	9.517-1	8.437-1	8.934-1	9.308-1	9.572-1	9.853-1	1.015-0	1.047-0
17	[illegible]	9.439-1	8.656-1	8.219-1	8.554-1	9.053-1	9.359-1	9.639-1	9.926-1	1.023-0
18	1.533-0	9.149-1	9.596-1	9.233-1	8.141-1	9.742-1	9.154-1	9.434-1	9.711-1	1.030-0

Table 96 (cont'd)

(CN RE) (3/2))

V	10	11	12	13	14	15	16	17	18
1	1.673-[illegible]	1.317-0	1.401-0	1.324-0	1.367-0	1.290-0	1.044-0	1.314-0	1.240-0
1	1.241-[illegible]	1.121-0	1.317-0	1.232-0	1.553-0	1.335-0	1.501-0	1.339-0	1.187-0
2	2.941-1	1.265-0	1.195-0	1.583-0	1.271-0	1.059-0	1.413-0	1.267-0	1.635-0
3	1.646-[illegible]	3.996-0	1.240-0	1.243-0	2.477-0	1.262-0	1.171-0	1.594-0	1.306-0
4	1.652-[illegible]	1.737-0	2.517-0	1.224-[illegible]	1.192-[illegible]	5.842-0	1.258-0	1.165-0	4.892-1
5	1.55[illegible]-[illegible]	1.669-0	1.754-0	2.322-0	1.141-0	1.267-0	1.220-0	1.261-0	1.193-0
6	1.481-[illegible]	1.587-0	1.670-0	1.795-0	2.174-0	1.165-0	1.186-0	8.729-1	1.216-0
7	1.421-0	1.490-0	1.575-0	1.694-0	1.915-0	2.255-0	1.161-0	1.234-0	2.249-0
8	1.394-[illegible]	1.431-0	1.494-0	1.593-0	1.583-0	1.924-0	2.242-0	4.031-1	1.305-0
9	1.3[illegible]6-[illegible]	1.443-0	1.494-0	1.507-0	1.592-0	1.762-0	1.836-0	2.181-0	2.200-0
10	2.121-[illegible]	1.317-0	9.939-0	1.451-0	1.516-0	1.600-0	1.711-0	1.847-0	2.174-0
11	1.230-[illegible]	1.213-0	1.328-0	1.301-0	1.462-0	1.525-0	1.609-0	1.719-0	1.860-0
12	1.188-0	1.250-0	1.252-0	1.340-0	1.349-0	1.475-0	1.534-0	1.618-0	1.729-0
13	1.136-0	1.199-0	1.270-0	1.270-0	1.353-0	1.371-0	1.430-0	1.544-0	1.627-0
14	1.161-[illegible]	1.154-[illegible]	1.210-0	1.312-0	1.243-0	1.369-0	1.346-0	1.508-0	1.554-0
15	1.111-0	1.421-0	1.107-0	1.221-0	4.434-0	1.296-0	1.392-0	1.399-0	1.536-0
16	1.041-[illegible]	1.123-[illegible]	1.1[illegible]3-[illegible]	1.179-0	1.234-0	1.199-0	1.308-0	1.436-0	1.410-0
17	1.[illegible]95-[illegible]	1.090-0	1.140-0	1.133-0	1.139-0	1.250-0	1.234-0	1.321-0	1.708-0
18	1.031-[illegible]	1.003-0	1.099-0	1.195-0	1.144-0	1.199-0	1.275-0	1.255-0	1.335-0

Table 97

R-CENTROIDS FOR (CH VIOLET)

J	IV	1	2	3	4	5	6	7	8	9
1	1.1[illegible]-1	1.1[illegible]-1	9.735-1	9.279-1	9.[illegible]-1	9.039-1	8.[illegible]-1	1.227-1	1.067-0	3.399-0
2	1.2[illegible]-0	1.1[illegible]-1	1.[illegible]-1	9.463-1	9.157-1	9.[illegible]-1	7.[illegible]-1	9.137-1	1.316-0	1.144-0
3	1.[illegible]-1	1.2[illegible]-1	1.147-1	1.[illegible]-0	9.9[illegible]-1	9.15[illegible]-1	8.[illegible]-1	7.[illegible]-1	3.056-1	1.65[illegible]-0
4	2.[illegible]-0	1.[illegible]-1	1.[illegible]-1	1.139-[illegible]	1.[illegible]-1	9.934-1	9.144-1	8.452-1	7.515-1	5.241-1
5	1.[illegible]-0	3.746-1	1.[illegible]-0	1.315-0	1.212-0	1.[illegible]-0	1.[illegible]-1	9.150-1	8.[illegible]-1	7.460-1
6	1.[illegible]-1	1.[illegible]-1	8.693-1	1.59[illegible]-1	1.328-1	1.[illegible]-0	1.[illegible]-1	1.[illegible]-1	9.111-1	4.554-1
7	1.[illegible]-1	1.[illegible]-1	1.[illegible]-1	1.[illegible]-1	1.674-1	1.343-0	1.[illegible]-1	1.[illegible]-1	1.119-0	9.[illegible]-1
8	1.[illegible]-1	1.1[illegible]-1	1.377-1	1.[illegible]-0	1.173-0	1.[illegible]-0	1.[illegible]-0	1.[illegible]-0	9.973-1	1.032-0
9	1.[illegible]-1	3.[illegible]-1	1.[illegible]-0	1.402-[illegible]	1.[illegible]-0	1.253-0	2.[illegible]-0	1.[illegible]-0	1.276-0	9.466-1
10	1.[illegible]-1	1.172-1	1.[illegible]-0	1.339-0	1.141-0	2.[illegible]-0	1.[illegible]-0	1.367-1	1.404-0	1.291-0
11	1.[illegible]-1	1.[illegible]-1	1.174-1	9.913-1	1.525-0	1.383-0	7.[illegible]-0	1.391-0	7.968-1	1.434-0
12	1.246-0	1.[illegible]-1	1.131-1	1.142-0	2.[illegible]-0	1.559-0	1.[illegible]-0	6.374-1	1.458-0	1.041-0
13	1.[illegible]-1	1.[illegible]-1	9.949-1	1.175-0	1.2[illegible]-0	1.19[illegible]-0	1.[illegible]-0	1.625-1	1.062-0	1.554-0
14	1.[illegible]-0	1.177-1	1.316-0	1.185-0	8.930-1	1.[illegible]-0	1.[illegible]-0	1.210-0	1.910-0	1.222-0
15	1.[illegible]-0	1.[illegible]-1	1.130-1	1.265-0	1.237-0	1.289-0	1.[illegible]-0	1.478-1	1.413-0	5.224-0.
16	1.[illegible]-1	1.[illegible]-1	1.[illegible]-1	1.198-0	1.[illegible]-0	1.511-0	1.[illegible]-0	1.234-1	1.[illegible]-0	1.546-0
17	1.[illegible]-1	2.417-0	1.077-1	1.126-0	1.112-1	2.117-0	1.[illegible]-1	1.[illegible]-1	1.386-0	1.097-0
18	1.2[illegible]-1	1.[illegible]-1	1.[illegible]-1	9.77[illegible]-1	1.2[illegible]-0	1.541-0	1.[illegible]-0	1.396-1	9.549-1	1.549-0
19	1.2[illegible]-1	1.2[illegible]-1	2.[illegible]-0	9.755-1	1.193-0	3.[illegible]-1	1.[illegible]-0	1.016-0	1.495-0	1.354-0

Table 97 (cont'd)

(CN VIOLET)

V	V 10	11	12	13	14	15	16	17	18
0	1.137-0	1.044-0	8.946-1	9.412-1	1.216-0	9.026-1	1.057-0	1.100-0	1.170-0
1	7.691-1	1.201-0	1.124-0	1.023-0	1.341-0	1.141-0	1.048-0	9.009-1	9.258-1
2	1.214-0	1.025-0	1.239-0	1.164-0	1.146-0	1.142-0	1.128-0	1.101-0	1.030-0
3	3.234-1	1.301-0	1.050-0	1.126-0	1.498-0	3.336-1	9.822-1	1.054-0	1.032-0
4	5.956-1	7.773-1	1.325-0	1.134-0	9.159-1	1.758-0	6.835-1	1.056-0	1.033-0
5	7.516-1	4.745-1	7.532-1	1.305-0	1.129-0	1.053-0	7.491-1	9.309-1	6.179-1
6	4.522-1	7.530-1	4.596-1	4.145-0	1.249-0	1.074-0	1.045-0	9.986-1	3.314-1
7	8.935-1	8.468-1	7.427-1	4.374-1	8.913-0	1.296-0	1.074-0	9.969-1	9.738-1
8	1.049-0	8.745-1	8.536-1	7.211-1	4.813-1	3.633-0	1.304-0	1.090-0	9.498-1
9	8.614-1	1.074-0	8.405-1	9.670-1	5.919-1	4.983-1	3.838-0	1.332-0	1.119-0
10	1.304-0	5.983-1	1.108-0	7.798-1	8.853-1	6.281-1	5.560-1	5.328-0	1.400-0
11	1.474-0	1.316-0	3.371-1	1.151-0	6.512-1	9.402-1	4.835-1	7.003-1	9.706-1
12	1.204-0	1.540-0	1.326-0	1.270-0	1.213-0	3.035-1	1.038-0	9.624-1	4.112-1
13	1.754-0	1.230-0	1.618-0	1.331-0	1.219-0	1.260-0	1.206-0	1.150-0	1.073-0
14	1.332-0	2.913-0	1.335-0	2.771-0	1.330-0	3.508-0	1.319-0	5.662-0	1.257-0
15	5.276-1	1.408-0	5.094-1	1.347-0	8.657-1	1.320-0	2.520-0	1.364-0	2.640-0
16	1.742-0	1.046-0	1.516-0	1.272-0	1.442-0	1.179-0	1.298-0	2.398-0	1.408-0
17	1.368-0	2.560-0	1.246-0	1.729-0	1.233-0	1.524-0	1.252-0	1.247-0	2.377-0
18	4.175-1	1.533-0	2.599-1	1.354-0	3.458-0	1.319-0	1.745-0	1.298-0	1.131-0

Table 98

R-CENTROIDS FOR (D +M +)

V	0	1	2	3	4	5	6	7	8	9	10	11	12
[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.2[illegible]-[illegible]	1.2[illegible]-[illegible]	1.[illegible]-[illegible]	1.332-[illegible]	1.3[illegible]-[illegible]	1.39[illegible]-[illegible]	1.425-[illegible]	1.4[illegible]-[illegible]	1.4[illegible]-[illegible]	1.[illegible]-[illegible]	1.613-[illegible]
1	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.213-[illegible]	1.25[illegible]-[illegible]	1.274-[illegible]	1.3[illegible]-[illegible]	1.341-[illegible]	1.372-[illegible]	1.403-[illegible]	1.433-[illegible]	1.467-[illegible]	1.504-[illegible]	1.526-[illegible]
2	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.227-[illegible]	1.244-[illegible]	1.29[illegible]-[illegible]	1.31[illegible]-[illegible]	1.344-[illegible]	1.3[illegible]-[illegible]	1.411-[illegible]	1.441-[illegible]	1.473-[illegible]	1.5[illegible]-[illegible]
3	1.122-[illegible]	1.15[illegible]-[illegible]	1.17[illegible]-[illegible]	1.174-[illegible]	1.2[illegible]-[illegible]	1.266-[illegible]	1.424-[illegible]	1.324-[illegible]	1.357-[illegible]	1.3[illegible]-[illegible]	1.419-[illegible]	1.45[illegible]-[illegible]	1.479-[illegible]
4	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.19[illegible]-[illegible]	1.216-[illegible]	1.[illegible]-[illegible]	1.275-[illegible]	1.30[illegible]-[illegible]	1.342-[illegible]	1.[illegible]-[illegible]	1.397-[illegible]	1.427-[illegible]	1.454-[illegible]
5	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.171-[illegible]	1.224-[illegible]	1.228-[illegible]	1.253-[illegible]	1.284-[illegible]	1.315-[illegible]	1.342-[illegible]	1.376-[illegible]	1.4[illegible]-[illegible]	1.436-[illegible]
6	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.12[illegible]-[illegible]	1.153-[illegible]	1.142-[illegible]	1.20[illegible]-[illegible]	1.240-[illegible]	1.265-[illegible]	1.359-[illegible]	1.[illegible]-[illegible]	1.354-[illegible]	1.37[illegible]-[illegible]	1.415-[illegible]
7	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.135-[illegible]	1.154-[illegible]	1.20[illegible]-[illegible]	1.21[illegible]-[illegible]	1.221-[illegible]	1.278-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.3[illegible]-[illegible]	1.392-[illegible]
8	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.119-[illegible]	1.147-[illegible]	1.17[illegible]-[illegible]	1.19[illegible]-[illegible]	1.231-[illegible]	1.256-[illegible]	1.291-[illegible]	1.315-[illegible]	1.33[illegible]-[illegible]	1.374-[illegible]
9	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.103-[illegible]	1.131-[illegible]	1.15[illegible]-[illegible]	1.197-[illegible]	1.21[illegible]-[illegible]	1.23[illegible]-[illegible]	1.[illegible]-[illegible]	1.277-[illegible]	1.327-[illegible]	1.353-[illegible]
10	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.088-[illegible]	1.114-[illegible]	1.143-[illegible]	1.172-[illegible]	1.192-[illegible]	1.225-[illegible]	1.248-[illegible]	1.282-[illegible]	1.3[illegible]-[illegible]	1.340-[illegible]
11	9.898-1	1.[illegible]-[illegible]	1.044-[illegible]	1.072-[illegible]	1.099-[illegible]	1.13[illegible]-[illegible]	1.156-[illegible]	1.195-[illegible]	1.215-[illegible]	1.240-[illegible]	1.263-[illegible]	1.3[illegible]-[illegible]	1.319-[illegible]
12	9.735-1	1.[illegible]-[illegible]	1.023-[illegible]	1.057-[illegible]	1.[illegible]-[illegible]	1.13[illegible]-[illegible]	1.141-[illegible]	1.171-[illegible]	1.197-[illegible]	1.219-[illegible]	1.248-[illegible]	1.276-[illegible]	1.294-[illegible]
13	9.[illegible]-1	9.873-1	1.[illegible]-[illegible]	1.043-[illegible]	1.07[illegible]-[illegible]	1.[illegible]-[illegible]	1.123-[illegible]	1.15[illegible]-[illegible]	1.2[illegible]-[illegible]	1.2[illegible]-[illegible]	1.235-[illegible]	1.259-[illegible]	1.292-[illegible]
14	9.348-1	9.73[illegible]-1	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.056-[illegible]	1.[illegible]-[illegible]	9.27[illegible]-1	1.141-[illegible]	1.176-[illegible]	1.163-[illegible]	1.216-[illegible]	1.23[illegible]-[illegible]	1.273-[illegible]
15	9.115-1	9.[illegible]-1	9.[illegible]-1	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.131-[illegible]	1.155-[illegible]	1.[illegible]-[illegible]	1.199-[illegible]	1.232-[illegible]	1.256-[illegible]
16	8.[illegible]-1	9.[illegible]-1	9.722-1	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.143-[illegible]	1.143-[illegible]	1.[illegible]-[illegible]	1.181-[illegible]	1.21[illegible]-[illegible]	1.[illegible]-[illegible]
17	8.[illegible]-1	9.[illegible]-1	9.[illegible]-1	9.36[illegible]-1	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.154-[illegible]	9.937-1	1.199-[illegible]	1.231-[illegible]
18	8.457-1	9.[illegible]-1	9.346-1	9.723-1	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.135-[illegible]	1.147-[illegible]	1.[illegible]-[illegible]	1.18[illegible]-[illegible]	1.215-[illegible]
19	8.[illegible]-1	9.[illegible]-1	9.[illegible]-1	9.575-1	9.[illegible]-1	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	9.779-1	1.139-[illegible]	1.164-[illegible]	1.[illegible]-[illegible]	1.201-[illegible]
20	8.273-1	8.[illegible]-1	9.[illegible]-1	9.[illegible]-1	9.754-1	1.[illegible]-[illegible]	8.[illegible]-[illegible]	1.[illegible]-[illegible]	9.232-1	1.131-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]-[illegible]

Table 98 (cont'd)

(CO 4T4 +)

JV	13	14	15	16	17	18	19	20	21	22	23	24
V												
0	1.37c-0	1.5?1-0	1.240-0	8.955-1	1.325-0	1.124-0	9.412-1	1.447-0	1.242-0	2.311-1	8.8?9-1	1.176-?
1	1.5?6-0	1.5?8-?	1.765-0	1.264-0	1.115-?	1.33?-?	1.027-0	9.177-1	1.12?-0	1.126-0	1.235-?	1.224-?
2	1.525-0	1.5?6-?	1.?45-0	3.363-0	1.129-?	1.?91-?	1.3?5-0	1.259-0	1.41?-0	1.252-?	5.?16-0	1.696-?
3	1.51?-0	1.538-?	1.5?9-0	1.702-0	1.443-1	1.?30-?	1.?23-0	1.?55-0	1.4?3-0	1.?83-?	1.3?5-0	1.196-?
4	1.487-0	1.?18-?	1.553-0	1.590-?	1.639-0	1.?49-?	1.549-0	1.732-0	1.359-?	1.590-?	1.484-0	1.437-0
5	1.466-0	1.496-?	1.529-0	1.5?1-?	1.593-?	1.?22-0	1.642-0	1.636-0	2.168-0	1.322-?	1.431-0	1.491-?
6	1.445-0	1.475-0	1.5?5-0	1.536-?	1.557-0	1.5?9-?	1.628-0	1.639-0	1.719-?	2.006-0	1.997-0	1.522-?
7	1.428-0	1.455-?	1.494-0	1.513-0	1.544-?	1.?75-?	1.606-0	1.643-0	1.677-0	1.717-?	1.7?2-0	1.736-0
8	1.402-0	1.428-0	1.4?5-0	1.493-?	1.522-0	1.?53-?	1.?84-0	1.616-0	1.649-?	1.693-0	1.711-0	1.754-?
9	1.388-0	1.413-?	1.441-?	1.446-0	1.503-?	1.?32-?	1.562-0	1.593-0	1.624-?	1.656-?	1.698-0	1.725-?
10	1.364-0	1.388-?	1.424-0	1.452-?	1.477-0	1.517-0	1.542-0	1.571-0	1.602-0	1.633-?	1.6?5-0	1.7?0-?
11	1.335-?	1.376-0	1.4?3-?	1.433-?	1.462-?	1.489-0	1.475-0	1.553-0	1.581-0	1.611-?	1.643-0	1.675-?
12	1.332-0	1.356-?	1.3?0-0	1.415-?	1.439-0	1.475-0	1.501-0	1.526-0	1.569-0	1.592-?	1.622-0	1.653-0
13	1.313-0	1.351-0	1.3?9-?	1.391-?	1.426-0	1.453-0	1.5?9-0	1.513-0	1.539-0	1.555-0	1.6?5-0	1.633-0
14	1.287-0	1.326-0	1.347-?	1.342-?	1.4?7-?	1.443-?	1.465-0	1.49?-0	1.527-0	1.550-0	1.575-0	1.636-0
15	1.287-0	1.3?8-0	1.342-0	1.364-?	1.399-?	1.420-0	1.441-0	1.477-0	1.503-0	1.475-0	1.5?3-0	1.597-?
16	1.271-0	1.253-0	1.323-0	1.333-?	1.377-0	1.4?1-?	1.434-0	1.457-0	1.499-0	1.516-0	1.539-0	1.591-0
17	1.256-0	1.296-0	1.3?6-0	1.333-0	1.36?-0	1.392-0	1.415-0	1.453-0	1.471-0	1.494-?	1.538-0	1.553-0
18	1.241-0	1.271-0	1.1o9-0	1.322-0	1.2?0-?	1.374-?	1.395-0	1.43?-0	1.452-0	1.487-?	1.51?-0	1.625-?
19	1.232-0	1.2?7-0	1.237-0	1.3?7-0	1.34?-?	1.358-0	1.39?-0	1.415-0	1.449-0	1.469-0	1.439-0	1.524-0
2?	1.223-0	1.244-0	5.233-0	1.291-?	1.579-?	1.342-0	2.642-0	1.399-0	1.446-0	6.97?-?	1.3?8-0	5.446-0

Table 99 R-CENTROIDS FOR (N(2) 1ST. +)

V' / V	1	2	3	4	5	6
0	1.254-0	1.216-0	1.143-0	1.152-0	1.125-0	1.103-0	1.077-0
1	1.344-0	1.317-0	1.227-0	1.192-0	1.161-0	1.133-0	1.119-0
2	1.347-0	1.319-0	1.237-0	1.249-0	1.213-0	1.171-0	1.142-0
3	1.423-0	1.357-0	1.323-0	1.271-0	1.139-0	1.219-0	1.181-0
4	1.453-0	1.412-0	1.367-0	1.367-0	1.243-0	1.236-0	1.279-0
5	1.547-0	1.477-0	1.421-0	1.374-0	1.244-0	1.296-0	1.249-0
6	1.647-0	1.553-0	1.496-0	1.431-0	1.389-0	1.322-0	1.315-0
7	1.734-0	1.657-0	1.564-0	1.495-0	1.441-0	1.407-0	1.337-0
8	2.241-0	1.774-0	1.666-0	1.574-0	1.515-0	1.452-0	1.439-0
9	1.195-0	2.033-0	1.749-0	1.673-0	1.534-0	1.515-0	1.453-0
10	1.195-0	1.164-0	2.042-0	1.919-0	1.636-0	1.593-0	1.525-0
11	1.028-0	1.951-0	1.969-0	2.068-0	1.931-0	1.696-0	1.603-0
12	1.276-0	1.641-0	1.246-0	2.059-0	2.051-0	1.940-0	1.717-0
13	1.203-0	1.104-0	1.506-0	1.335-0	3.034-0	2.099-0	1.853-0
14	9.517-1	1.121-0	1.296-0	1.722-0	1.523-0	5.097-0	2.144-0
15	1.355-0	1.233-0	8.219-1	1.316-0	3.850-0	1.397-0	3.349-0
16	1.306-0	1.509-0	5.991-1	1.219-0	1.170-0	1.064-0	1.427-0
17	1.331-0	1.355-0	1.391-0	2.195-0	1.232-0	9.941-1	1.031-0

Table 99 (cont'd)

(V(2) 1ST. +)

V	/V /	8	9	10	11	12	13
[illegible]	1.[illegible]-0	1.030-0	1.018-0	9.99[illegible]-1	9.927-1	9.880-1	9.563-1
1	1.088-0	1.064-0	1.044-0	1.026-0	1.010-0	9.928-1	9.775-1
2	1.117-0	1.093-0	1.072-0	1.053-0	1.035-0	1.019-0	1.002-0
3	1.152-0	1.126-0	1.102-0	1.081-0	1.061-0	1.043-0	1.026-0
4	1.193-0	1.162-0	1.135-0	1.111-0	1.090-0	1.070-0	1.052-0
5	1.193-0	1.214-0	1.173-0	1.145-0	1.121-0	1.099-0	1.079-0
6	1.262-0	1.214-0	4.452-0	1.184-0	1.156-0	1.131-0	1.109-0
7	1.338-0	1.274-0	1.233-0	1.185-0	1.223-0	1.170-0	1.142-0
8	1.3[illegible]-0	1.251-0	1.296-0	1.245-0	1.206-0	1.111-0	1.191-0
9	1.475-0	1.363-0	1.298-0	1.317-0	1.258-0	1.221-0	1.190-0
10	1.479-0	1.352-0	1.377-0	1.317-0	1.548-0	1.274-0	1.234-0
11	1.535-0	1.483-0	1.393-0	1.395-0	1.332-0	1.251-0	1.295-0
12	1.614-0	1.547-0	1.5[illegible]7-0	1.414-0	1.425-0	1.347-0	1.230-0
13	1.718-0	1.625-0	1.558-0	1.530-0	1.430-0	1.528-0	1.362-0
14	1.855-0	1.729-0	1.638-0	1.571-0	1.572-0	1.444-0	1.297-0
15	2.172-0	1.879-0	1.741-0	1.647-0	1.544-0	1.749-0	1.459-0
16	2.474-0	2.201-0	1.893-0	1.753-0	1.659-0	1.598-0	1.236-0
17	1.571-0	2.223-0	2.245-0	1.913-0	1.7[illegible]0-0	1.572-0	1.615-0

Table 100

R-CENTROIDS FOR (N(2) 2ND. +)

V' \ V	0	1	2	3	4	5	6	7	8
0	1.184-1	1.147-	1.114-1	1.083-1	1.055-1	1.029-1	1.004-1	9.799-1	9.561-1
1	1.228-1	1.210-1	1.193-1	1.121-1	1.140-1	1.062-1	1.036-1	1.011-1	9.871-1
2	1.278-1	1.238-1	1.154-1	1.155-1	1.129-1	1.098-1	1.069-1	1.043-1	1.018-1
3	1.341-	1.249-1	1.206-1	1.183-1	1.134-1	1.137-1	1.105-1	1.076-1	1.049-1
4	1.456-	1.334-1	1.313-1	1.281-1	1.134-1	1.150-1	1.145-1	1.111-1	1.082-1

V' \ V	9	10	11	12	13	14	15	16	17
0	9.314-1	9.069-1	8.826-1	8.614-1	8.465-1	8.392-1	8.341-1	8.394-1	8.353-1
1	9.641-1	9.413-1	9.183-1	8.951-1	8.729-1	8.545-1	8.420-1	8.329-1	8.143-1
2	9.944-1	9.716-1	9.485-1	9.291-1	9.157-1	8.847-1	8.622-1	8.435-1	8.146-1
3	1.022-	1.011-1	9.788-1	9.570-1	9.358-1	9.153-1	8.945-1	8.713-1	8.429-1
4	1.055-	1.038-1	1.017-1	9.854-1	9.639-1	9.423-1	9.210-1	9.031-1	8.742-1

Table 101

R-CENTROIDS FOR(42 3-M 1)

J	VV	1	2	3	4	5	6	7	8	9	10
0	1.2[illegible]-0	1.224-0	1.242-0	1.242-0	1.276-0	1.292-0	1.309-0	1.325-0	1.341-0	1.357-0	1.373-0
1	1.2[illegible]-0	1.214-0	1.236-0	1.236-0	1.270-0	1.287-0	1.303-0	1.319-0	1.336-0	1.352-0	1.367-0
2	1.194-0	1.213-0	1.230-0	1.230-0	1.265-0	1.281-0	1.298-0	1.314-0	1.330-0	1.346-0	1.361-0
3	1.188-0	1.207-0	1.225-0	1.225-0	1.259-0	1.276-0	1.292-0	1.308-0	1.324-0	1.339-0	1.362-0
4	1.182-0	1.201-0	1.219-0	1.219-0	1.254-0	1.270-0	1.287-0	1.303-0	1.317-0	1.336-0	1.351-0
5	1.176-0	1.196-0	1.214-0	1.214-0	1.249-0	1.265-0	1.281-0	1.294-0	1.314-0	1.329-0	1.345-0
6	1.170-0	1.190-0	1.209-0	1.209-0	1.243-0	1.260-0	1.276-0	1.292-0	1.308-0	1.323-0	1.338-0
7	1.164-0	1.184-0	1.203-0	1.203-0	1.238-0	1.256-0	1.271-0	1.287-0	1.302-0	1.317-0	1.335-0
8	1.158-0	1.179-0	1.198-0	1.198-0	1.234-0	1.248-0	1.265-0	1.281-0	1.297-0	1.314-0	1.329-0
9	1.151-0	1.173-0	1.193-0	1.193-0	1.223-0	1.243-0	1.258-0	1.276-0	1.292-0	1.308-0	1.323-0
10	1.145-0	1.168-0	1.188-0	1.188-0	1.221-0	1.239-0	1.255-0	1.278-0	1.287-0	1.302-0	1.316-0
11	1.139-0	1.163-0	1.183-0	1.183-0	1.216-0	1.233-0	1.254-0	1.266-0	1.282-0	1.297-0	1.313-0
12	1.132-0	1.158-0	1.181-0	1.181-0	1.211-0	1.229-0	1.244-0	1.261-0	1.277-0	1.293-0	1.308-0
13	1.125-0	1.154-0	1.111-0	1.111-0	1.207-0	1.212-0	1.239-0	1.256-0	1.278-0	1.287-0	1.302-0
14	1.118-0	1.151-0	1.160-0	1.160-0	1.203-0	1.217-0	1.234-0	1.252-0	1.267-0	1.282-0	1.296-0
15	1.111-0	1.156-0	1.157-0	1.157-0	5.126-1	1.213-0	1.230-0	1.243-0	1.262-0	1.278-0	1.294-0
16	1.104-0	1.325-0	1.154-0	1.154-0	1.198-0	1.209-0	1.226-0	1.248-0	1.257-0	1.263-0	1.289-0
17	1.096-0	1.088-0	1.150-0	1.150-0	1.186-0	1.205-0	1.220-0	1.236-0	1.254-0	1.267-0	1.284-0
18	1.098-0	1.098-0	1.149-0	1.149-0	1.183-0	1.203-0	1.216-0	1.231-0	1.243-0	1.263-0	1.280-0
19	1.079-0	1.096-0	1.150-0	1.150-0	1.180-0	1.192-0	1.212-0	1.226-0	1.242-0	1.259-0	1.263-0
20	1.068-0	1.091-0	1.102-0	1.102-0	1.179-0	1.197-0	1.208-0	1.226-0	1.237-0	1.253-0	1.267-0

Table 101 (cont'd)

(M(2) 3-4 1)

J	11	12	13	14	15	16	17	18	19	20	21
0	1.3[illegible]	1.4[illegible]	1.422-0	1.439-0	1.456-[illegible]	1.472-0	1.490-0	1.507-0	1.525-0	1.543-0	1.562-0
1	1.3[illegible]	1.3[illegible]	1.415-0	1.430-0	1.459-[illegible]	1.4[illegible]-0	1.484-0	1.501-0	1.518-0	1.536-0	1.555-0
2	1.3[illegible]	1.4[illegible]	1.411-0	1.427-0	1.443-[illegible]	1.459-0	1.475-0	1.499-0	1.520-0	1.532-0	1.549-0
3	1.3[illegible]	1.398-[illegible]	1.414-0	1.419-0	1.434-0	1.459-0	1.471-0	1.497-0	1.513-0	1.519-0	1.538-0
4	1.3[illegible]	1.392-[illegible]	1.395-0	1.414-0	1.431-0	1.447-0	1.462-0	1.476-0	1.505-0	1.516-0	1.532-0
5	1.3[illegible]	1.389-[illegible]	1.393-0	1.4[illegible]-0	1.423-0	1.437-0	1.451-0	1.474-0	1.489-0	1.514-0	1.534-0
6	1.397-0	1.371-[illegible]	1.396-0	1.411-0	1.430-0	1.435-0	1.459-0	1.465-0	1.465-0	1.502-0	1.517-0
7	1.3[illegible]-0	1.365-[illegible]	1.378-0	1.399-0	1.413-[illegible]	1.427-0	1.440-0	1.454-0	1.477-0	1.492-0	1.502-0
8	1.344-[illegible]	1.355-[illegible]	1.377-0	1.391-0	1.4[illegible]-[illegible]	1.422-0	1.439-0	1.454-0	1.467-0	1.497-0	1.504-0
9	1.334-[illegible]	1.395-0	1.370-0	1.393-0	1.407-[illegible]	1.417-0	1.431-0	1.442-0	1.467-0	1.480-0	1.493-0
10	1.334-[illegible]	1.349-[illegible]	1.363-0	1.383-0	1.395-[illegible]	1.419-0	1.433-0	1.443-0	1.457-0	1.469-0	1.494-0
11	1.328-[illegible]	1.342-[illegible]	1.362-[illegible]	1.374-0	1.389-0	1.405-0	1.421-0	1.435-0	1.443-0	1.469-0	1.482-0
12	1.322-[illegible]	1.343-[illegible]	1.354-0	1.363-0	1.413-0	1.410-0	1.414-0	1.413-0	1.447-0	1.460-0	1.469-0
13	1.474-0	1.334-[illegible]	1.348-0	1.357-0	1.379-[illegible]	1.393-0	1.394-0	1.426-0	1.439-0	1.442-0	1.472-0
14	1.313-0	1.328-[illegible]	1.340-0	1.359-0	1.373-0	1.390-0	1.405-0	1.418-0	1.420-0	1.451-0	1.463-0
15	1.3[illegible]-0	1.322-[illegible]	1.339-0	1.353-0	1.364-0	1.385-0	1.398-0	1.437-0	1.438-0	1.443-0	1.433-0
16	1.3[illegible]-0	1.321-[illegible]	1.333-0	1.347-0	1.366-[illegible]	1.378-0	1.388-0	1.409-0	1.423-0	1.426-0	1.455-0
17	1.292-0	1.314-[illegible]	1.328-0	1.346-0	1.359-0	1.371-0	1.392-0	1.402-0	1.413-0	1.435-0	1.447-0
18	1.295-0	1.319-[illegible]	1.316-0	1.339-0	1.353-0	1.374-0	1.394-0	1.394-0	1.415-0	1.427-0	1.433-0
19	1.291-0	1.3[illegible]-0	1.322-0	1.333-0	1.344-[illegible]	1.364-0	1.378-0	1.401-0	1.407-0	1.413-0	1.439-0
20	1.295-[illegible]	1.3[illegible]-	1.315-0	1.324-0	1.344-[illegible]	1.357-0	1.378-0	1.389-0	1.399-0	1.419-0	1.438-0

Table 102

R-CENTROIDS FOR(N2 3-H 2)

J	VV	1	2	3	4	5	6	7	8	9	10
	1.1[illegible]-0	1.145-0	1.212-0	1.212-0	1.257-0	1.278-0	1.298-0	1.317-0	1.336-0	1.355-0	1.373-0
1	1.1[illegible]-0	1.174-0	1.236-0	1.236-0	1.282-0	1.304-0	1.324-0	1.344-0	1.363-0	1.382-0	1.400-0
2	1.1[illegible]-0	1.170-0	1.230-0	1.230-0	1.276-0	1.298-0	1.318-0	1.338-0	1.357-0	1.376-0	1.394-0
3	1.1[illegible]-0	1.162-0	1.226-0	1.226-0	1.272-0	1.294-0	1.314-0	1.334-0	1.353-0	1.372-0	1.390-0
4	1.116-0	1.156-0	1.170-0	1.170-0	1.232-0	1.254-0	1.274-0	1.292-0	1.312-0	1.330-0	1.346-0
5	1.1[illegible]-0	1.195-0	1.107-0	1.107-0	1.243-0	1.242-0	1.266-0	1.286-0	1.309-0	1.323-0	1.342-0
6	1.0[illegible]-0	1.12[illegible]-0	1.159-0	1.159-0	1.2[illegible]-0	1.237-0	1.261-0	1.274-0	1.297-0	1.316-0	1.335-0
7	1.0[illegible]-0	1.113-0	1.151-0	1.151-0	1.204-0	1.233-0	1.259-0	1.271-0	1.291-0	1.311-0	1.327-0
8	1.0[illegible]-0	1.1[illegible]-0	1.144-0	1.144-0	1.200-0	1.039-0	1.241-0	1.265-0	1.291-0	1.302-0	1.320-0
9	1.0[illegible]-0	1.092-0	1.137-0	1.137-0	1.2[illegible]-0	1.257-0	1.236-0	1.271-0	1.275-0	1.295-0	1.313-0
10	1.0[illegible]-0	1.0[illegible]-0	1.110-0	1.110-0	1.121-0	1.203-0	1.233-0	1.243-0	1.270-0	1.291-0	1.307-0
11	1.0[illegible]-0	1.0[illegible]-0	1.103-0	1.103-0	1.155-0	1.139-0	1.179-0	1.240-0	1.266-0	1.277-0	1.301-0
12	1.0[illegible]-0	1.0[illegible]-0	1.094-0	1.094-0	1.151-0	1.201-0	1.206-0	1.235-0	2.341-1	1.274-0	1.296-0
13	1.0[illegible]-0	1.0[illegible]-0	1.084-0	1.084-0	1.144-0	1.342-0	1.243-0	1.233-0	1.243-0	1.269-0	1.310-0
14	9.947-1	1.0[illegible]-0	1.074-0	1.074-0	1.136-0	1.140-0	1.200-0	7.167-1	1.240-0	1.265-0	1.276-0
15	9.9[illegible]5-1	1.0[illegible]-0	1.064-0	1.064-0	1.127-0	1.145-0	1.199-0	1.235-0	1.236-0	1.619-0	1.273-0
16	9.853-1	1.0[illegible]-0	1.055-0	1.055-0	1.116-0	1.142-0	1.210-0	1.233-0	1.235-0	1.246-0	1.268-0
17	9.771-1	1.0[illegible]-0	1.046-0	1.046-0	1.100-0	1.135-0	9.170-1	1.200-0	1.247-0	1.243-0	1.263-0
18	9.719-1	1.0[illegible]-0	1.037-0	1.037-0	1.323-0	1.128-0	1.128-0	1.197-0	1.193-0	1.240-0	1.261-0
19	9.673-1	9.931-1	1.029-0	1.029-0	1.119-0	1.120-0	1.137-0	1.196-0	1.199-0	1.239-0	1.250-0
20	9.639-1	9.[illegible]-1	1.021-0	1.021-0	1.113-0	1.111-0	1.135-0	1.201-0	1.194-0	1.239-0	1.248-0
21	9.6[illegible]3-1	9.814-1	1.014-0	1.014-0	1.094-0	1.110-0	1.131-0	1.239-0	1.196-0	1.253-0	1.245-0
22	9.579-1	9.7[illegible]-1	1.009-0	1.009-0	1.093-0	1.088-0	1.127-0	9.001-1	1.193-0	1.219-0	1.242-0
23	9.5[illegible]-1	9.734-1	1.002-0	1.002-0	1.079-0	1.067-0	1.120-0	1.119-0	1.191-0	1.193-0	1.240-0
24	9.55[illegible]-1	9.7[illegible]3-1	9.979-1	9.979-1	1.073-0	9.134-1	1.114-0	1.126-0	1.199-0	1.190-0	1.240-0

Table 102 (cont'd)

(N(2) 3-4 2)

J	VV 11	12	13	14	15	16	17	18	19	20	21
[illegible]	1.342-[illegible]	1.41[illegible]-[illegible]	1.429-[illegible]	1.446-[illegible]	1.455-[illegible]	1.444-[illegible]	1.503-[illegible]	1.523-[illegible]	1.543-[illegible]	1.564-[illegible]	1.585-[illegible]
[illegible]	1.[illegible]-[illegible]	1.4[illegible]-[illegible]	1.422-[illegible]	1.440-[illegible]	1.459-[illegible]	1.477-[illegible]	1.496-[illegible]	1.516-[illegible]	1.536-[illegible]	1.556-[illegible]	1.577-[illegible]
2	1.3[illegible]-[illegible]	1.394-[illegible]	1.416-[illegible]	1.434-[illegible]	1.453-[illegible]	1.471-[illegible]	1.490-[illegible]	1.509-[illegible]	1.529-[illegible]	1.549-[illegible]	1.570-[illegible]
3	1.373-[illegible]	1.391-[illegible]	1.342-[illegible]	1.429-[illegible]	1.447-[illegible]	1.465-[illegible]	1.483-[illegible]	1.502-[illegible]	1.521-[illegible]	1.541-[illegible]	1.562-[illegible]
4	1.367-[illegible]	1.385-[illegible]	1.403-[illegible]	1.420-[illegible]	1.438-[illegible]	1.456-[illegible]	1.477-[illegible]	1.495-[illegible]	1.514-[illegible]	1.533-[illegible]	1.554-[illegible]
5	1.359-[illegible]	1.377-[illegible]	1.339-[illegible]	1.414-[illegible]	1.431-[illegible]	1.449-[illegible]	1.465-[illegible]	2.488-[illegible]	1.508-[illegible]	1.526-[illegible]	1.546-[illegible]
6	1.355-[illegible]	1.371-[illegible]	1.348-[illegible]	1.405-[illegible]	1.439-[illegible]	1.444-[illegible]	1.460-[illegible]	1.477-[illegible]	1.494-[illegible]	1.465-[illegible]	1.542-[illegible]
7	1.346-[illegible]	1.363-[illegible]	1.376-[illegible]	1.400-[illegible]	1.417-[illegible]	1.433-[illegible]	1.446-[illegible]	1.473-[illegible]	1.489-[illegible]	1.516-[illegible]	1.521-[illegible]
8	1.34[illegible]-[illegible]	1.358-[illegible]	1.374-[illegible]	1.391-[illegible]	1.407-[illegible]	1.430-[illegible]	1.445-[illegible]	1.461-[illegible]	1.475-[illegible]	1.515-[illegible]	1.518-[illegible]
9	1.338-[illegible]	1.355-[illegible]	1.367-[illegible]	1.384-[illegible]	1.402-[illegible]	1.419-[illegible]	1.433-[illegible]	1.459-[illegible]	1.473-[illegible]	1.499-[illegible]	1.498-[illegible]
10	1.324-[illegible]	1.343-[illegible]	1.361-[illegible]	1.378-[illegible]	1.394-[illegible]	1.396-[illegible]	1.431-[illegible]	1.447-[illegible]	1.460-[illegible]	1.498-[illegible]	1.501-[illegible]
11	1.317-[illegible]	1.334-[illegible]	1.354-[illegible]	1.371-[illegible]	1.389-[illegible]	1.405-[illegible]	1.422-[illegible]	1.428-[illegible]	1.460-[illegible]	1.474-[illegible]	1.447-[illegible]
12	1.316-[illegible]	1.329-[illegible]	1.347-[illegible]	1.364-[illegible]	1.383-[illegible]	1.397-[illegible]	1.434-[illegible]	1.434-[illegible]	1.459-[illegible]	1.452-[illegible]	1.497-[illegible]
13	1.3[illegible]-[illegible]	1.322-[illegible]	1.339-[illegible]	1.358-[illegible]	1.376-[illegible]	1.419-[illegible]	1.416-[illegible]	1.425-[illegible]	1.238-[illegible]	1.463-[illegible]	1.476-[illegible]
14	1.3[illegible]-[illegible]	1.314-[illegible]	1.334-[illegible]	1.351-[illegible]	1.379-[illegible]	1.398-[illegible]	1.462-[illegible]	1.293-[illegible]	1.438-[illegible]	1.454-[illegible]	1.375-[illegible]
15	1.298-[illegible]	1.314-[illegible]	1.329-[illegible]	1.344-[illegible]	1.362-[illegible]	1.341-[illegible]	1.385-[illegible]	1.415-[illegible]	1.429-[illegible]	1.427-[illegible]	1.467-[illegible]
16	1.3[illegible]-[illegible]	1.3[illegible]-[illegible]	1.323-[illegible]	1.343-[illegible]	1.356-[illegible]	1.376-[illegible]	1.394-[illegible]	1.438-[illegible]	1.414-[illegible]	1.442-[illegible]	1.458-[illegible]
17	1.274-[illegible]	1.3[illegible]-[illegible]	1.318-[illegible]	1.336-[illegible]	1.350-[illegible]	1.366-[illegible]	1.387-[illegible]	1.400-[illegible]	1.423-[illegible]	1.434-[illegible]	1.449-[illegible]
18	1.273-[illegible]	1.3[illegible]-[illegible]	1.313-[illegible]	1.331-[illegible]	1.339-[illegible]	1.362-[illegible]	1.382-[illegible]	1.414-[illegible]	1.415-[illegible]	1.429-[illegible]	1.448-[illegible]
19	1.269-[illegible]	1.3[illegible]-[illegible]	1.309-[illegible]	1.327-[illegible]	1.347-[illegible]	1.357-[illegible]	1.378-[illegible]	1.394-[illegible]	1.408-[illegible]	1.443-[illegible]	1.441-[illegible]
20	1.265-[illegible]	1.27[illegible]-[illegible]	1.3[illegible]-[illegible]	1.325-[illegible]	1.340-[illegible]	1.351-[illegible]	1.358-[illegible]	1.398-[illegible]	1.401-[illegible]	1.424-[illegible]	1.434-[illegible]
21	1.2[illegible]-[illegible]	1.275-[illegible]	1.3[illegible]-[illegible]	1.318-[illegible]	1.335-[illegible]	1.342-[illegible]	1.365-[illegible]	1.383-[illegible]	1.402-[illegible]	1.417-[illegible]	1.424-[illegible]
22	1.257-[illegible]	1.273-[illegible]	1.239-[illegible]	1.310-[illegible]	1.332-[illegible]	1.349-[illegible]	1.361-[illegible]	1.379-[illegible]	1.396-[illegible]	1.413-[illegible]	1.459-[illegible]
23	1.2[illegible]-[illegible]	1.27[illegible]-[illegible]	1.3[illegible]-[illegible]	1.3[illegible]-[illegible]	1.329-[illegible]	1.3[illegible]-[illegible]	1.356-[illegible]	1.376-[illegible]	1.391-[illegible]	1.407-[illegible]	1.427-[illegible]
24	1.2[illegible]-[illegible]	1.2[illegible]-[illegible]	1.2[illegible]-[illegible]	1.3[illegible]-[illegible]	1.332-[illegible]	1.341-[illegible]	1.351-[illegible]	1.376-[illegible]	1.396-[illegible]	1.425-[illegible]	1.422-[illegible]

Table 103

R-CENTROIDS FOR (42+ MEINEL)

W	0	1	2	3	4	5	6	7	8	9	10	11	12
[illegible]	1.157-[illegible]	1.191-[illegible]	1.234-0	1.276-0	1.332-0	1.404-[illegible]	1.462-0	1.454-[illegible]	2.042-0	1.208-[illegible]	7.733-1	1.274-0	1.141-[illegible]
1	1.166-[illegible]	1.131-[illegible]	1.201-0	1.238-0	1.293-0	1.338-[illegible]	1.403-[illegible]	1.489-0	1.513-0	2.931-[illegible]	1.253-0	1.334-0	1.405-0
2	1.[illegible]94-[illegible]	1.[illegible]13-[illegible]	1.159-0	1.221-0	1.247-0	1.291-[illegible]	1.344-[illegible]	1.413-0	1.498-0	1.574-[illegible]	2.978-1	1.278-0	1.371-[illegible]
3	1.[illegible]79-0	1.[illegible]19-[illegible]	1.23[illegible]-[illegible]	1.169-[illegible]	1.12[illegible]-0	1.257-[illegible]	1.298-0	1.352-0	1.419-0	1.512-[illegible]	1.663-[illegible]	[illegible].414-1	1.314-[illegible]
4	1.[illegible]52-[illegible]	1.[illegible]41-[illegible]	1.115-[illegible]	1.129-[illegible]	1.190-[illegible]	1.196-[illegible]	1.27[illegible]-[illegible]	1.366-0	1.359-0	1.428-[illegible]	1.526-0	1.[illegible]58-[illegible]	[illegible].384-1
5	1.032-[illegible]	1.[illegible]99-[illegible]	1.048-[illegible]	1.134-[illegible]	1.141-0	1.194-[illegible]	1.21[illegible]-[illegible]	1.[illegible]94-0	1.315-0	1.367-[illegible]	1.437-0	1.[illegible]38-[illegible]	1.743-0
6	1.013-0	1.[illegible]34-[illegible]	1.0[illegible]5-[illegible]	1.[illegible]95-0	1.194-0	1.151-[illegible]	1.237-[illegible]	1.22[illegible]-0	1.594-0	1.326-[illegible]	1.376-0	1.44[illegible]-[illegible]	1.5[illegible]-0
7	9.954-1	1.[illegible]14-[illegible]	1.143-[illegible]	1.[illegible]71-[illegible]	1.13[illegible]-0	1.11[illegible]-[illegible]	1.161-[illegible]	1.125-0	1.230-0	1.2[illegible]2-0	1.338-0	1.38[illegible]-[illegible]	1.455-0
8	9.788-1	9.49[illegible]-[illegible]	1.123-[illegible]	1.[illegible]49-0	1.[illegible]77-0	1.154-[illegible]	1.125-0	1.172-0	1.174-0	1.241-[illegible]	1.243-0	1.352-0	1.394-0
9	9.611-1	9.821-1	1.[illegible]84-[illegible]	1.029-0	1.[illegible]55-0	1.[illegible]85-[illegible]	1.084-[illegible]	1.135-0	1.191-0	1.189-[illegible]	1.254-0	1.26[illegible]-0	1.372-[illegible]
1[illegible]	9.4[illegible]1-1	9.[illegible]41-1	9.[illegible][illegible]-1	1.[illegible]1-[illegible]	1.[illegible]35-[illegible]	1.[illegible]51-[illegible]	1.[illegible]9[illegible]-[illegible]	1.103-0	1.144-0	1.2[illegible]5-[illegible]	1.199-0	1.275-0	1.272-0
11	9.127-1	9.[illegible]6-1	9.[illegible]4-1	9.[illegible]2[illegible]-1	1.[illegible]16-[illegible]	1.[illegible]41-[illegible]	1.[illegible]68-[illegible]	2.163-0	1.113-0	1.154-[illegible]	1.114-0	1.2[illegible]9-[illegible]	1.326-0
12	9.708-1	9.251-1	9.[illegible]23-1	9.746-1	9.977-1	1.[illegible]22-[illegible]	1.047-[illegible]	1.[illegible]77-0	1.078-0	1.122-[illegible]	1.167-0	1.15[illegible]-[illegible]	1.219-0
13	9.[illegible]3[illegible]-1	9.[illegible]17-1	9.[illegible]43-1	9.575-1	9.[illegible]13-1	1.[illegible]04-[illegible]	1.[illegible]29-[illegible]	1.[illegible]53-0	1.094-0	1.093-[illegible]	1.138-[illegible]	1.192-[illegible]	1.172-[illegible]
14	7.936-1	9.[illegible]4[illegible]-1	9.127-1	9.[illegible]01-1	9.635-1	9.[illegible]63-1	1.[illegible]1[illegible]-[illegible]	1.[illegible]34-0	1.[illegible]51-[illegible]	9.876-1	1.103-[illegible]	1.14[illegible]-[illegible]	1.4[illegible]9-[illegible]
15	7.922-1	9.364-1	9.[illegible]56-1	9.216-1	9.456-1	9.695-1	9.927-1	1.[illegible]15-[illegible]	1.[illegible]40-0	1.[illegible]78-[illegible]	1.072-0	1.111-[illegible]	[illegible].151-[illegible]
16	9.48[illegible]-1	9.[illegible]41-1	9.[illegible]91-1	9.[illegible]09-1	9.231-1	9.532-1	9.758-1	9.991-1	1.[illegible]22-0	1.[illegible]46-[illegible]	1.[illegible]89-[illegible]	1.[illegible]45-[illegible]	1.12[illegible]-[illegible]
17	9.223-1	9.[illegible]34-1	9.[illegible]17-1	9.[illegible]60-1	9.[illegible]36-1	9.354-1	9.594-1	9.823-1	1.[illegible]35-[illegible]	1.[illegible]29-[illegible]	1.054-[illegible]	1.[illegible]27-[illegible]	1.[illegible]94-[illegible]
18	9.[illegible]84-1	9.[illegible]12-1	9.[illegible]21-1	9.465-1	9.[illegible]35-1	9.[illegible]35-1	9.434-1	9.[illegible]69-1	9.[illegible]96-1	1.[illegible]11-[illegible]	1.[illegible]34-[illegible]	1.[illegible]62-[illegible]	1.[illegible]64-[illegible]
19	9.[illegible]37-1	9.[illegible]27-1	9.434-1	9.[illegible]49-1	8.[illegible]79-1	9.[illegible]06-1	9.272-1	9.[illegible]93-1	9.725-1	9.948-1	1.017-[illegible]	1.[illegible]4[illegible]-[illegible]	1.[illegible]83-[illegible]
2[illegible]	9.113-1	9.[illegible]13-1	9.[illegible]12-1	9.[illegible]01-1	9.[illegible]13-1	9.795-1	9.[illegible]98-1	9.[illegible]33-1	9.565-1	9.[illegible]98-1	1.[illegible]01-[illegible]	1.[illegible]23-[illegible]	1.[illegible]47-[illegible]

Table 103 (cont'd)

(N2+ MEINEL)

J	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	1.277-[illegible]	1.2[illegible]	1.3[illegible]	1.19[illegible]-1	1.257-[illegible]	1.4[illegible]-[illegible]	1.215-[illegible]	1.227-[illegible]	1.134-0	1.236-[illegible]	1.217-[illegible]	1.141-[illegible]	1.332-[illegible]
	1.74[illegible]-[illegible]	1.[illegible]	1.234-[illegible]	9.592-1	1.26[illegible]-[illegible]	1.21[illegible]-[illegible]	1.413-[illegible]	1.331-[illegible]	1.[illegible]78-[illegible]	1.328-[illegible]	1.385-[illegible]	1.12[illegible]-[illegible]	1.24[illegible]-[illegible]
	1.738-[illegible]	1.1[illegible]	1.572-[illegible]	1.412-[illegible]	1.33[illegible]-[illegible]	1.756-[illegible]	1.218-[illegible]	1.241-[illegible]	1.629-[illegible]	1.2[illegible]-[illegible]	1.214-[illegible]	9.3[illegible]-1	1.4[illegible]-[illegible]
	1.[illegible]89-[illegible]	1.[illegible]-[illegible]	1.223-[illegible]	9.992-1	1.33[illegible]-[illegible]	1.16[illegible]-[illegible]	1.295-[illegible]	1.543-[illegible]	1.33[illegible]-[illegible]	1.526-[illegible]	9.467-1	1.167-[illegible]	1.205-[illegible]
	1.373-[illegible]	1.21[illegible]	1.[illegible]3-[illegible]	1.256-[illegible]	1.[illegible]3-[illegible]	1.374-[illegible]	1.204-[illegible]	8.[illegible]91-1	1.4[illegible]-[illegible]	1.156-[illegible]	9.151-1	1.454-1	1.1[illegible]-[illegible]
	3.[illegible]83-[illegible]	1.[illegible]-[illegible]	1.27[illegible]-[illegible]	9.488-1	1.239-[illegible]	1.184-[illegible]	1.[illegible]61-[illegible]	1.[illegible]83-[illegible]	1.154-0	1.449-[illegible]	1.272-[illegible]	1.[illegible]45-[illegible]	2.37[illegible]-[illegible]
	1.77[illegible]-[illegible]	1.[illegible]-[illegible]	1.[illegible]55-[illegible]	1.2[illegible]-[illegible]	1.178-[illegible]	1.324-[illegible]	1.196-[illegible]	8.917-1	1.372-[illegible]	1.272-[illegible]	1.178-[illegible]	1.[illegible]61-[illegible]	1.31[illegible]-[illegible]
	1.[illegible]62-[illegible]	1.[illegible]-[illegible]	9.[illegible]83-1	1.[illegible]66-[illegible]	1.137-[illegible]	1.28[illegible]-[illegible]	1.334-[illegible]	1.232-[illegible]	9.359-1	1.524-[illegible]	1.187-[illegible]	1.141-[illegible]	1.151-[illegible]
	1.464-[illegible]	1.[illegible]-[illegible]	1.43[illegible]-[illegible]	6.7[illegible]-1	1.727-[illegible]	1.45[illegible]-[illegible]	1.354-[illegible]	1.[illegible]11-[illegible]	1.237-[illegible]	1.152-[illegible]	1.[illegible]70-[illegible]	1.295-[illegible]	9.[illegible]3-1
	1.414-[illegible]	1.47[illegible]-[illegible]	1.[illegible]3[illegible]-[illegible]	1.[illegible]48[illegible]-[illegible]	1.[illegible]69-[illegible]	1.726-[illegible]	2.284-[illegible]	1.244-[illegible]	1.711-0	1.248-[illegible]	1.275-[illegible]	7.[illegible]68-1	1.34[illegible]-[illegible]
1	1.41[illegible]-[illegible]	1.41[illegible]-[illegible]	1.434-[illegible]	1.[illegible]61-[illegible]	1.372-[illegible]	1.262-[illegible]	1.814-0	5.951-1	1.731-0	1.812-[illegible]	9.756-1	1.31[illegible]-[illegible]	1.281-0
11	1.283-[illegible]	1.4[illegible]-[illegible]	1.425-[illegible]	1.494-[illegible]	1.[illegible]13-[illegible]	2.1[illegible]-[illegible]	1.3[illegible]-[illegible]	1.96[illegible]-0	1.372-0	1.732-[illegible]	1.897-[illegible]	2.031-[illegible]	1.277-0
12	1.269-[illegible]	1.[illegible]-[illegible]	1.71[illegible]-[illegible]	1.434-[illegible]	1.[illegible]36-[illegible]	1.637-[illegible]	2.351-0	1.434-[illegible]	2.273-0	1.494-[illegible]	1.924-[illegible]	1.481-[illegible]	1.324-[illegible]
13	2.2[illegible]-[illegible]	1.17[illegible]-[illegible]	1.3.2-[illegible]	[illegible].[illegible]47-1	1.[illegible]51-[illegible]	1.[illegible]18-[illegible]	1.[illegible]58-[illegible]	2.947-[illegible]	1.[illegible]03-[illegible]	3.244-[illegible]	1.578-[illegible]	1.[illegible]63-[illegible]	1.61[illegible]-[illegible]
14	1.18[illegible]-[illegible]	1.24[illegible]-[illegible]	1.2[illegible]-[illegible]	1.311-[illegible]	1.11[illegible]-[illegible]	1.[illegible]6[illegible]-[illegible]	1.53[illegible]-[illegible]	1.[illegible]41-[illegible]	8.[illegible]53-[illegible]	1.[illegible]68-[illegible]	1.628-[illegible]	1.67[illegible]-[illegible]	8.393-1
15	1.1[illegible]-[illegible]	1.[illegible]-[illegible]	1.2[illegible]-[illegible]	1.23[illegible]-[illegible]	1.321-[illegible]	1.197-[illegible]	1.481-[illegible]	1.544-0	1.719-0	1.647-[illegible]	1.630-[illegible]	[illegible].269-1	1.747-[illegible]
16	1.16[illegible]-[illegible]	1.[illegible]-[illegible]	1.2[illegible]-[illegible]	1.292-[illegible]	1.251-[illegible]	1.331-[illegible]	1.229-[illegible]	1.493-[illegible]	1.[illegible]58-0	1.743-[illegible]	7.953-1	1.7[illegible]-[illegible]	1.[illegible]46-[illegible]
17	1.[illegible]28-[illegible]	1.[illegible]-[illegible]	1.1[illegible]-[illegible]	1.212-[illegible]	1.[illegible]95-[illegible]	1.25[illegible]-[illegible]	1.342-[illegible]	1.[illegible]33-[illegible]	1.516-0	1.572-[illegible]	1.[illegible]85-[illegible]	1.132-[illegible]	1.794-[illegible]
18	1.1[illegible]-[illegible]	1.[illegible]-[illegible]	2.2[illegible]-[illegible]	1.171-[illegible]	1.223-[illegible]	7.[illegible]82-1	1.264-[illegible]	1.[illegible]52-[illegible]	1.233-[illegible]	1.535-[illegible]	1.[illegible]98-[illegible]	1.841-[illegible]	1.[illegible]86-[illegible]
19	1.[illegible]79-[illegible]	1.111-[illegible]	[illegible].[illegible]44-[illegible]	1.[illegible]94-[illegible]	1.131-[illegible]	1.235-[illegible]	1.145-[illegible]	1.277-[illegible]	1.[illegible]63-[illegible]	1.23[illegible]-[illegible]	1.554-[illegible]	1.6[illegible]-[illegible]	1.924-[illegible]
2[illegible]	[illegible].[illegible]38-[illegible]	1.[illegible]-[illegible]	1.1[illegible]-[illegible]	1.16[illegible]-[illegible]	1.133-[illegible]	1.19[illegible]-[illegible]	1.25[illegible]-[illegible]	1.191-[illegible]	1.294-[illegible]	1.374-[illegible]	1.209-[illegible]	1.574-[illegible]	1.624-[illegible]

Table 104

R-CENTROIDS FOR (N2+ 1ST. NEG.)

V' \ V	0	1	2	3	4	5	6	7	8	9	10
0	[illegible]	[illegible]	1.711-0	9.740-1	9.439-1	9.257-1	9.179-1	9.025-1	8.342-1	5.579-1	1.253-0
1	1.193-0	1.111-0	1.057-0	1.017-0	9.828-1	9.517-1	9.239-1	9.017-1	8.809-1	8.391-1	6.915-1
2	1.218-0	1.161-0	1.137-0	1.104-0	1.023-0	9.976-1	9.564-1	9.265-1	8.979-1	8.739-1	8.510-1
3	1.314-0	1.233-0	1.179-0	1.278-0	1.070-0	1.024-0	9.912-1	9.599-1	9.317-1	9.032-1	8.743-1
4	1.535-0	1.337-0	1.239-0	1.181-0	9.450-1	1.073-0	1.034-0	9.955-1	9.632-1	9.351-1	9.090-1
5	1.159-0	2.461-0	1.364-0	1.250-0	1.135-0	1.010-0	1.072-0	1.038-0	9.992-1	9.671-1	9.375-1
6	9.492-1	1.218-0	1.983-1	1.410-0	1.264-0	1.211-0	9.793-1	1.059-0	1.044-0	1.011-0	9.703-1
7	1.001-0	1.113-0	1.241-0	1.018-0	1.495-0	1.230-0	1.227-0	8.960-1	9.992-1	1.053-0	1.030-0
8	1.196-0	1.160-0	3.475-0	1.359-0	1.150-0	1.756-0	1.300-0	1.245-0	5.525-1	6.977-1	1.067-0
9	1.122-0	4.185-0	1.309-0	1.011-0	1.514-0	1.243-0	1.286-0	1.327-0	1.262-0	9.024-0	6.234-0
10	1.100-0	1.115-0	2.325-0	1.396-0	1.215-0	2.608-0	1.314-0	1.047-0	1.366-0	1.276-0	1.968-0
11	2.178-0	1.118-0	4.552-0	1.109-0	2.427-0	1.322-0	9.539-1	1.409-0	1.190-0	1.465-0	1.286-0
12	1.235-0	1.129-0	1.071-0	1.295-1	1.303-0	9.956-1	1.484-0	1.197-0	1.732-0	1.251-0	1.287-0
13	1.078-0	1.269-0	1.161-0	1.038-0	1.107-0	1.573-0	1.248-0	1.290-0	1.303-0	8.017-1	1.315-0
14	8.949-1	1.163-0	1.189-0	1.767-0	3.950-1	1.279-0	7.067-1	1.395-0	1.076-0	1.433-0	1.172-0
15	8.277-1	1.135-0	1.126-0	1.248-0	1.525-0	1.338-0	1.512-0	1.214-0	1.942-0	1.251-0	2.546-0
16	9.253-1	1.107-0	1.147-0	1.357-0	1.263-0	1.265-0	1.292-0	6.773-1	1.367-0	9.540-1	1.372-0
17	1.132-0	5.085-1	1.136-0	2.310-0	1.125-0	1.494-0	1.084-0	1.567-0	1.206-0	1.778-0	1.224-0
18	1.110-0	1.549-0	1.104-0	1.014-0	7.687-1	1.201-0	4.025-0	1.326-0	8.149-1	1.370-0	9.111-1
19	1.341-0	1.271-0	1.028-0	1.117-0	3.198-1	1.041-0	1.470-0	1.181-0	1.727-0	1.225-0	1.969-0
20	1.011-0	1.143-0	2.560-0	1.143-0	8.525-1	9.917-1	1.284-0	7.499-1	1.376-0	9.867-1	1.409-0

Table 104 (cont'd)

(N2+ 1ST. NEG.)

V' \ V	11	12	13	14	15	16	17	18	19	20
0	1.1[illegible]-0	1.057-0	1.078-0	1.054-0	1.035-0	9.935-1	1.594-1	1.104-0	1.063-0	1.035-0
1	9.7[illegible]-1	1.021-0	4.806-0	9.975-1	1.027-0	1.018-0	9.957-1	8.201-1	1.083-0	1.046-0
2	8.[illegible]52-1	8.[illegible]3-1	2.079-0	1.230-0	7.732-1	9.962-1	1.022-0	1.010-0	9.113-1	1.048-0
3	8.[illegible]-1	8.253-1	7.766-1	9.125-1	7.048-1	7.126-1	7.141-1	1.047-0	1.100-0	1.193-0
4	8.8[illegible]8-1	8.[illegible]1-1	8.223-1	7.950-1	7.298-1	7.358-1	6.891-0	1.602-0	1.283-0	1.424-0
5	9.1[illegible]-1	8.953-1	8.568-1	8.213-1	7.855-1	7.459-1	6.356-1	9.653-1	1.583-0	1.260-0
6	9.4[illegible]2-1	9.131-1	8.875-1	8.520-1	8.240-1	7.941-1	7.277-1	6.573-1	4.523-1	7.623-1
7	9.725-1	9.424-1	9.157-1	8.885-1	8.619-1	8.341-1	7.958-1	7.397-1	6.589-1	5.742-1
8	9.[illegible]2-1	9.7[illegible]4-1	9.4[illegible]5-1	9.171-1	8.9[illegible]0-1	8.631-1	8.341-1	8.041-1	7.649-1	7.075-1
9	1.[illegible]95-0	9.773-1	9.825-1	9.564-1	9.175-1	8.9[illegible]4-1	8.659-1	8.358-1	8.083-1	7.735-1
10	1.[illegible]46-0	1.142-0	9.322-1	9.077-1	9.251-1	9.238-1	8.875-1	8.583-1	8.401-1	8.138-1
11	1.[illegible]0-0	1.703-0	1.201-0	9.153-1	1.031-0	9.951-1	9.[illegible]20-1	8.787-[illegible]	8.718-1	8.424-1
12	1.2[illegible]-0	1.522-0	1.663-0	1.259-0	4.656-1	1.089-0	8.193-1	9.636-1	8.576-1	8.791-1
13	1.191-0	1.27[illegible]-0	1.484-0	1.656-[illegible]	1.3[illegible]4-0	1.243-0	1.159-0	6.111-1	1.018-0	8.039-1
14	1.393-0	1.2[illegible]9-0	1.170-0	1.452-0	1.7[illegible]3-0	1.335-0	3.372-0	1.253-0	1.199-0	1.108-0
15	1.2[illegible]4-0	2.027-0	1.240-0	2.576-0	1.370-0	1.885-0	1.351-0	2.302-0	1.327-0	9.655-0
16	1.[illegible]51-0	1.330-0	1.187-0	1.273-0	1.559-0	1.643-0	4.[illegible]20-0	1.346-0	2.103-0	1.384-0
17	1.714-0	1.228-0	1.459-0	1.261-0	1.139-0	1.495-0	1.815-0	1.020-0	1.385-0	2.099-0
18	1.349-0	9.351-1	1.303-0	9.961-1	1.277-0	2.973-0	1.417-0	1.836-0	1.269-0	1.151-0
19	1.218-0	1.624-0	1.207-0	1.397-0	1.237-0	1.253-0	1.557-0	1.954-1	2.358-0	1.332-0
20	9.706-1	1.353-0	9.106-1	1.295-0	4.716-1	1.273-0	9.392-1	1.437-0	1.924-0	8.177-1

Table 105

R-CENTROIDS FOR (N2+ 2ND. NES.)

VV	0	1	2	3	4	5	6	7	8	9	10
0	1.195-0	1.213-0	1.232-0	1.253-0	1.277-0	1.304-0	1.338-0	1.385-0	1.475-0	2.140-0	1.258-0
1	1.176-0	1.194-0	1.211-0	1.229-0	1.248-0	1.268-0	1.319-0	1.342-0	1.390-0	1.496-0	2.715-0
2	1.163-0	1.178-0	1.193-0	1.213-0	1.230-0	1.229-0	1.298-0	1.315-0	1.347-0	1.396-0	1.497-0
3	1.148-0	1.161-0	1.199-0	1.195-0	1.199-0	1.239-0	1.246-0	1.447-0	1.325-0	1.353-0	1.402-0
4	1.135-0	1.145-0	1.166-0	1.176-0	1.203-0	1.211-0	1.206-0	1.252-0	1.220-0	1.342-0	1.361-0
5	1.128-0	1.135-0	1.150-0	1.096-0	1.191-0	1.172-0	1.216-0	1.212-0	1.261-0	1.249-0	1.373-0
6	1.111-0	1.126-0	1.136-0	1.156-0	1.163-0	1.187-0	1.193-0	1.224-0	1.225-0	1.275-0	1.258-0
7	1.099-0	1.115-0	1.120-0	1.140-0	1.135-0	1.158-0	9.915-1	1.198-0	1.330-0	1.230-0	1.410-0
8	1.089-0	1.103-0	1.051-0	1.125-0	1.149-0	1.151-0	1.173-0	1.176-0	1.203-0	1.196-0	1.236-0
9	1.079-0	1.092-0	1.112-0	1.113-0	1.131-0	1.129-0	1.155-0	1.203-0	1.182-0	1.212-0	1.238-0
10	1.072-0	1.082-0	1.098-0	1.097-0	1.118-0	1.144-0	1.140-0	1.160-0	1.169-0	1.196-0	1.947-0

VV	11	12	13	14	15	16	17	18	19	20
0	1.515-0	1.143-0	1.569-0	1.148-0	1.672-0	1.236-0	2.327-0	1.351-0	9.191-1	1.562-0
1	1.3 3-0	1.737-0	1.228-0	1.734-0	1.248-0	2.217-0	1.332-0	3.621-1	1.480-0	1.155-0
2	9.491-1	1.335-0	1.981-0	1.249-0	2.210-0	1.324-0	1.359-0	1.426-0	1.034-0	1.724-0
3	1.5 9-0	1.433-0	1.305-0	2.847-0	1.341-0	1.362-0	1.394-0	8.623-1	1.550-0	1.210-0
4	1.469-0	1.522-0	1.165-1	1.394-0	1.347-0	1.390-0	8.110-1	1.472-0	1.120-0	1.807-0
5	1.375-0	1.416-0	1.536-0	8.390-1	1.423-0	8.399-1	1.442-0	9.934-1	1.582-0	1.245-0
6	1.491-0	1.381-0	1.423-0	1.551-0	8.524-1	1.454-0	9.104-1	1.503-0	1.143-0	1.812-0
7	1.204-0	1.412-0	1.393-0	1.431-0	1.533-0	9.759-1	1.457-0	1.377-0	1.581-0	1.215-0
8	1.149-0	1.253-0	7.621-1	1.409-0	1.441-0	1.581-0	1.150-0	1.522-0	1.185-0	1.682-0
9	1.243-0	1.220-0	1.275-0	1.072-0	1.429-0	1.449-0	1.536-0	1.043-0	1.562-0	1.278-0
10	1.213-0	1.250-0	1.230-0	1.244-0	1.143-0	1.448-0	1.459-0	1.607-0	1.029-0	1.613-0

Table 106

P-CENTROIDS FOR (NO GAMMA (1/2))

W	0	1	2	3	4	5	6	7	8
0	1.1[illegible]	1.[illegible]41-0	1.[illegible]59-1	1.034-0	1.018-1	9.992-1	9.813-1	9.641-1	9.475-1
1	1.1[illegible]	1.156-0	1.133-1	1.[illegible]66-0	1.045-1	1.025-0	1.006-0	9.889-1	9.719-1
2	1.1[illegible]	1.145-0	1.115-1	1.097-0	1.079-0	1.053-0	1.032-0	1.013-0	9.944-1
3	1.2[illegible]	1.174-0	1.125-1	1.124-0	1.107-1	1.086-0	1.064-0	1.044-0	1.025-0
4	1.[illegible]	1.218-0	1.184-1	1.149-0	1.140-1	1.116-0	1.090-0	1.067-0	1.050-0
5	1.278-0	1.244-0	1.215-1	1.201-0	1.158-1	1.137-0	1.115-0	1.089-1	1.064-0
6	1.326-0	1.285-0	1.252-1	1.223-1	1.154-1	1.167-0	1.133-0	1.134-1	1.097-1
7	1.377-0	1.331-0	1.292-1	1.259-0	1.232-1	1.191-1	1.179-0	1.144-1	1.116-0
8	1.4[illegible]	1.379-0	1.337-1	1.298-0	1.266-1	1.244-0	1.203-0	1.202-1	1.154-1
9	1.42[illegible]	1.421-0	1.385-1	1.343-0	1.316-0	1.273-0	1.240-0	1.213-1	1.135-1
10	1.4[illegible]	1.459-0	1.422-1	1.387-0	1.344-1	1.312-0	1.281-0	1.233-1	1.223-1
11	2.5[illegible]	1.482-0	1.438-1	1.421-0	1.390-0	1.354-1	1.319-0	1.289-1	1.251-0
12	1.211-[illegible]	1.504-0	1.443-1	1.439-0	1.424-1	1.395-0	1.350-0	1.326-1	1.298-0
13	1.4[illegible]5-0	1.509-0	1.448-1	1.469-0	1.449-0	1.430-1	1.400-0	1.367-1	1.333-0
14	1.1[illegible]2-[illegible]	1.213-0	0.657-1	1.591-0	1.499-1	1.461-0	1.436-0	1.407-0	1.373-0
15	0.232-1	1.249-0	1.254-1	1.017-0	1.662-1	1.513-0	1.479-0	1.443-1	1.413-0
16	1.212-1	1.196-0	1.151-0	1.172-0	2.338-1	1.567-0	1.517-0	1.479-1	1.451-[illegible]

Table 106 (cont'd) (40 GAMMA(1/2))

V	9	10	11	12	13	14	15	16	17
[illegible]	9.315-1	9.163-1	9.021-1	8.893-1	8.752-1	8.635-1	9.5[illegible]5-1	8.359-1	8.161-1
1	9.54[illegible]-1	9.348-1	9.236-1	9.090-1	8.953-1	8.824-1	9.[illegible]95-1	8.253-1	8.358-1
2	9.777-1	9.615-1	9.468-1	9.319-1	9.153-1	9.019-1	8.878-1	8.737-1	8.591-1
3	1.[illegible]02-[illegible]	9.847-1	9.684-1	9.528-1	9.379-1	9.234-1	9.091-1	8.945-1	8.796-1
4	1.[illegible]28-[illegible]	1.[illegible]59-[illegible]	9.918-1	9.754-1	9.587-1	9.447-1	9.301-1	9.159-1	9.019-1
5	1.2.5-[illegible]	1.037-[illegible]	1.017-[illegible]	9.998-1	9.825-1	9.668-1	9.516-1	9.370-1	9.228-1
6	1.[illegible]74-[illegible]	1.048-[illegible]	1.028-[illegible]	1.025-[illegible]	1.006-[illegible]	9.896-1	9.739-1	9.589-1	9.442-1
7	1.1[illegible]8-[illegible]	1.[illegible]82-[illegible]	1.060-[illegible]	1.031-[illegible]	1.[illegible]38-[illegible]	1.014-[illegible]	9.959-1	9.810-1	9.660-1
8	1.12[illegible]-[illegible]	1.131-[illegible]	1.[illegible]92-[illegible]	1.[illegible]69-[illegible]	1.049-[illegible]	9.918-1	1.[illegible]24-[illegible]	1.005-[illegible]	9.894-1
9	1.16[illegible]-[illegible]	1.132-[illegible]	1.[illegible]66-[illegible]	1.[illegible]74-[illegible]	1.[illegible]78-[illegible]	1.[illegible]58-[illegible]	1.038-[illegible]	1.[illegible]47-[illegible]	1.013-[illegible]
10	1.1[illegible]2-[illegible]	1.140-[illegible]	1.144-[illegible]	1.109-[illegible]	1.135-[illegible]	1.089-[illegible]	1.067-[illegible]	1.[illegible]49-[illegible]	1.030-[illegible]
11	1.234-[illegible]	1.196-[illegible]	1.222-[illegible]	1.155-[illegible]	1.124-[illegible]	1.[illegible]56-[illegible]	1.105-[illegible]	1.[illegible]78-[illegible]	1.058-[illegible]
12	1.2[illegible]2-[illegible]	1.249-[illegible]	1.2[illegible]8-[illegible]	1.149-[illegible]	1.168-[illegible]	1.135-[illegible]	1.103-[illegible]	1.151-[illegible]	1.091-[illegible]
13	1.315-[illegible]	1.271-[illegible]	1.330-[illegible]	1.220-[illegible]	1.191-[illegible]	1.189-[illegible]	1.148-[illegible]	1.119-[illegible]	1.059-[illegible]
14	1.3[illegible]1-[illegible]	1.3[illegible]1-[illegible]	1.279-[illegible]	1.243-[illegible]	1.234-[illegible]	1.197-[illegible]	5.573-[illegible]	1.161-[illegible]	1.132-[illegible]
15	1.3[illegible]1-[illegible]	1.351-[illegible]	1.3[illegible]8-[illegible]	1.284-[illegible]	1.263-[illegible]	1.248-[illegible]	1.212-[illegible]	1.169-[illegible]	1.143-[illegible]
16	1.422-[illegible]	1.392-[illegible]	1.371-[illegible]	1.334-[illegible]	1.278-[illegible]	1.274-[illegible]	1.255-[illegible]	1.226-[illegible]	1.188-[illegible]

Table 107

R-CENTROIDS FOR (NO GAMMA (3/2))

V	V	0	1	2	3	4	5	6	7	8
	0	1.113-0	1.093-0	1.075-0	1.059-0	1.041-0	1.026-0	1.012-0	9.987-1	9.859-1
	1	1.138-0	1.115-0	1.097-0	1.085-0	1.065-0	1.048-0	1.032-0	1.018-0	1.004-0
	2	1.164-0	9.405-1	1.123-0	1.101-0	1.079-0	1.067-0	1.056-0	1.039-0	1.024-0
	3	1.193-0	1.173-0	1.144-0	1.134-0	1.113-0	1.088-0	1.067-0	1.142-0	1.044-0
	4	1.225-0	1.208-0	1.203-0	1.153-0	1.124-0	1.126-0	1.096-0	1.076-0	1.056-0
	5	1.266-0	1.231-0	1.209-0	1.171-0	1.154-0	1.135-0	1.100-0	1.109-0	1.094-0
	6	1.306-0	1.266-0	1.234-0	1.221-0	1.143-0	1.216-0	1.144-0	1.118-0	9.795-1
	7	1.345-0	1.306-0	1.273-0	1.246-0	1.447-0	1.193-0	1.151-0	1.156-0	1.127-0
	8	1.386-0	1.349-0	1.312-0	1.279-0	1.254-0	1.210-0	1.203-0	1.168-0	1.212-0
	9	1.423-0	1.394-0	1.365-0	1.318-0	1.236-0	1.264-0	1.224-0	1.219-0	1.179-0
	10	1.544-0	1.431-0	1.396-0	1.359-0	1.323-0	1.293-0	1.287-0	1.234-0	1.219-0
	11	1.547-0	1.450-0	1.426-0	1.399-0	1.364-0	1.329-0	1.300-0	1.247-0	1.244-0
	12	1.274-0	1.425-0	1.444-0	1.429-0	1.403-0	1.369-0	1.336-0	1.308-0	1.269-0
	13	1.318-0	1.401-0	1.471-0	1.457-0	1.436-0	1.408-0	1.375-0	1.343-0	1.317-0
	14	1.2.8-0	1.164-0	1.765-0	1.515-0	1.470-0	1.443-0	1.414-0	1.381-0	1.350-0
	15	1.429-0	1.251-0	1.179-0	1.829-0	1.535-0	1.480-0	1.450-0	1.420-0	1.338-0
	16	1.265-0	1.197-0	1.241-0	1.793-0	1.652-0	1.535-0	1.498-0	1.457-0	1.429-0

Table 107 (cont'd)

(NO GAMMA(3/2))

J \ VV	9	10	11	12	13	14	15	16	17
0	9.736-1	9.619-1	9.508-1	9.403-1	9.303-1	9.207-1	9.114-1	9.019-1	9.919-1
1	9.915-1	9.793-1	9.676-1	9.563-1	9.454-1	9.350-1	9.257-1	9.161-1	9.064-1
2	1.021-0	9.972-1	9.849-1	9.733-1	9.622-1	9.514-1	9.410-1	9.309-1	9.210-1
3	1.051-0	1.026-0	1.013-0	9.997-1	9.879-1	9.767-1	9.670-1	9.466-1	9.364-1
4	7.791-1	1.041-0	1.023-0	1.009-0	9.966-1	9.846-1	9.732-1	9.624-1	9.521-1
5	1.066-0	1.047-0	9.301-1	1.033-0	1.016-0	1.003-0	9.906-1	9.790-1	9.691-1
6	1.094-0	1.074-0	1.056-0	1.034-0	9.360-1	1.026-0	1.010-0	9.967-1	9.853-1
7	1.120-0	1.127-0	1.083-0	1.064-0	1.048-0	1.031-0	9.069-1	1.018-0	1.003-0
8	1.136-0	1.111-0	1.079-0	1.100-0	1.073-0	1.056-0	1.041-0	1.025-0	7.805-1
9	1.155-0	1.150-0	1.121-0	1.097-0	1.024-0	1.086-0	1.065-0	1.049-0	1.035-0
10	1.190-0	1.157-0	1.259-0	1.132-0	1.108-0	1.083-0	1.177-0	1.076-0	1.058-0
11	1.253-0	1.234-0	1.169-0	1.125-0	1.148-0	1.118-0	1.096-0	1.066-0	1.133-0
12	1.254-0	1.217-0	1.232-0	1.181-0	1.149-0	1.254-0	1.131-0	1.107-0	1.085-0
13	1.284-0	1.268-0	1.230-0	1.239-0	1.193-0	1.162-0	1.121-0	1.151-0	1.119-0
14	1.343-0	1.288-0	1.330-0	1.242-0	1.200-0	1.215-0	1.173-0	1.143-0	1.139-0
15	1.354-0	1.299-0	1.293-0	1.259-0	1.255-0	1.220-0	1.393-0	1.198-0	1.156-0
16	1.398-0	1.374-0	1.298-0	1.290-0	1.243-0	1.266-0	1.235-0	1.190-0	1.210-0

Table 108

P-CENTROIDS FOR (NO BETA)

V	VV	0	1	2	3	4	5	6	7	8
	0	1.27[illegible]-0	1.286-0	1.303-0	1.320-0	1.337-0	1.355-0	1.373-0	1.393-0	1.412-0
	1	1.261-0	1.277-0	1.293-0	1.319-0	1.326-0	1.344-0	1.361-0	1.379-0	1.395-0
	2	1.252-0	1.264-0	1.284-0	1.300-0	1.316-0	1.333-0	1.348-0	1.398-0	1.380-0
	3	1.244-0	1.259-0	1.274-0	1.290-0	1.306-0	1.320-0	1.349-0	1.360-0	1.376-0
	4	1.236-0	1.251-0	1.266-0	1.281-0	1.295-0	1.326-0	1.332-0	1.347-0	1.353-0
	5	1.228-0	1.242-0	1.257-0	1.272-0	1.273-0	1.307-0	1.321-0	1.333-0	1.360-0
	6	1.220-0	1.234-0	1.249-0	1.262-0	1.283-0	1.296-0	1.309-0	1.335-0	1.346-0
	7	1.213-0	1.227-0	1.241-0	1.240-0	1.273-0	1.286-0	1.412-0	1.321-0	1.334-0
	8	1.205-0	1.219-0	1.232-0	1.253-0	1.264-0	1.275-0	1.298-0	1.310-0	1.313-0
	9	1.198-0	1.212-0	1.223-0	1.243-0	1.255-0	1.320-0	1.287-0	1.299-0	1.322-0
	10	1.192-0	1.205-0	1.195-0	1.235-0	1.246-0	1.257-0	1.277-0	1.454-0	1.310-0
	11	1.185-0	1.198-0	1.219-0	1.227-0	1.233-0	1.257-0	1.257-0	1.289-0	1.300-0
	12	1.179-0	1.191-0	1.209-0	1.220-0	1.247-0	1.248-0	1.248-0	1.279-0	1.288-0
	13	1.172-0	1.185-0	1.201-0	1.212-0	1.231-0	1.240-0	1.255-0	1.270-0	1.354-0
	14	1.166-0	1.179-0	1.194-0	1.205-0	1.223-0	1.232-0	1.252-0	1.260-0	1.282-0
	15	1.160-0	1.174-0	1.188-0	1.193-0	1.216-0	1.219-0	1.243-0	1.247-0	1.272-0
	16	1.154-0	1.165-0	1.182-0	1.201-0	1.219-0	1.238-0	1.235-0	1.279-0	1.263-0
	17	1.149-0	1.160-0	1.176-0	1.191-0	1.213-0	1.220-0	1.228-0	1.248-0	1.254-0
	18	1.143-0	1.154-0	1.170-0	1.184-0	1.196-0	1.212-0	1.220-0	1.239-0	1.243-0

Table 108 (cont'd)

(NO BETA)

VV V	9	10	11	12	13	14	15	16
0	1.412-0	1.433-0	1.454-0	1.476-0	1.501-0	1.525-0	1.550-0	1.577-0
1	1.395-0	1.433-0	1.444-0	1.464-0	1.485-0	1.509-0	1.534-0	1.561-0
2	1.390-0	1.404-0	1.426-0	1.441-0	1.486-0	1.496-0	1.519-0	1.543-0
3	1.376-0	1.391-0	1.425-0	1.437-0	1.455-0	1.472-0	1.525-0	1.531-0
4	1.358-0	1.389-0	1.404-0	1.419-0	1.484-0	1.467-0	1.485-0	1.502-0
5	1.361-0	1.373-0	1.387-0	1.419-0	1.431-0	1.447-0	1.917-0	1.498-0
6	1.346-0	1.358-0	1.389-0	1.400-0	1.412-0	1.449-0	1.459-0	1.473-0
7	1.334-0	1.367-0	1.371-0	1.383-0	1.415-0	1.426-0	1.436-0	1.474-0
8	1.323-0	1.345-0	1.357-0	1.391-0	1.396-0	1.405-0	1.439-0	1.451-0
9	1.322-0	1.333-0	1.235-0	1.369-0	1.381-0	1.411-0	1.420-0	1.406-0
10	1.318-0	1.329-0	1.345-0	1.356-0	1.395-0	1.393-0	1.397-0	1.433-0
11	1.301-0	1.334-0	1.333-0	1.335-0	1.368-0	1.377-0	1.407-0	1.416-0
12	1.288-0	1.311-0	1.321-0	1.347-0	1.355-0	1.415-0	1.390-0	1.389-0
13	1.354-0	1.308-0	1.301-0	1.333-0	1.339-0	1.367-0	1.375-0	1.404-0
14	1.282-0	1.291-0	1.314-0	1.322-0	1.355-0	1.354-0	1.742-0	1.387-0
15	1.272-0	1.278-0	1.301-0	1.309-0	1.333-0	1.341-0	1.367-0	1.373-0
16	1.263-0	1.318-0	1.291-0	1.374-0	1.322-0	9.291-1	1.353-0	1.313-0
17	1.254-0	1.270-0	1.282-0	1.304-0	1.311-0	1.334-0	1.341-0	1.367-0
18	1.243-0	1.260-0	1.269-0	1.293-0	1.294-0	1.322-0	1.318-0	1.353-0

Table 109

R-CENTROIDS FOR (NO DELTA (1/2))

V	VV 0	1	2	3	4	5	6	7	8	9	10	11
0	1.112-0	1.067-0	1.057-0	1.043-0	1.031-0	1.014-0	9.975-1	9.817-1	9.641-1	9.464-1	9.278-1	9.074-1
1	1.137-0	1.111-0	1.125-0	1.070-0	1.055-0	1.037-0	1.020-0	1.004-0	9.879-1	9.713-1	9.543-1	9.365-1
2	1.157-0	1.153-0	1.120-0	1.095-0	1.104-0	1.083-0	1.043-0	1.025-0	1.010-0	9.936-1	9.779-1	9.620-1
3	1.211-0	1.177-0	1.134-0	1.131-0	1.114-0	1.080-0	1.048-0	1.031-0	1.032-0	1.015-0	9.999-1	9.844-1
+	1.241-0	1.211-0	1.191-0	1.148-0	1.178-0	1.113-0	1.098-0	1.085-0	1.063-0	1.039-0	1.021-0	1.005-0

V	VV 12	13	14	15	16	17	18	19	20	21	22	23
0	8.884-1	8.583-1	8.315-1	8.124-1	8.133-1	8.348-1	8.359-1	8.751-1	9.770-1	9.922-1	1.004-0	1.011-0
1	9.114-1	8.993-1	8.814-1	8.590-1	8.244-1	7.246-1	9.181-1	1.192-0	1.058-0	1.014-0	9.855-1	9.599-1
2	9.456-1	9.281-1	9.081-1	8.836-1	8.501-1	7.945-1	8.939-1	9.631-1	1.233-0	1.068-0	1.011-0	9.780-1
3	9.634-1	9.514-1	9.341-1	9.142-1	8.907-1	8.582-1	8.053-1	8.931-1	1.065-0	1.397-0	1.032-0	1.016-0
+	9.839-1	9.744-1	9.580-1	9.404-1	9.211-1	8.491-1	8.714-1	8.294-1	7.439-1	3.799-1	1.664-0	1.143-0

Table 110

R-CENTROIDS FOR (NO DELTA (3/2))

V	VV 0	1	2	3	4	5	6	7	8	9	10	11
0	1.1[illegible]-0	1.[illegible]-0	1.068-0	1.0[illegible]-0	1.033-0	1.[illegible]-0	1.0[illegible]-0	9.834-1	9.654-1	9.469-1	9.291-1	9.137-1
1	1.1[illegible]-0	1.11[illegible]-0	1.195-0	1.[illegible]-0	1.057-0	1.[illegible]-0	1.023-0	1.007-0	9.908-1	9.748-1	9.581-1	9.405-1
2	1.1[illegible]-0	1.15[illegible]-0	1.121-0	1.096-0	1.016-0	1.[illegible]-0	1.045-0	1.028-0	1.012-0	9.967-1	9.811-1	9.652-1
3	1.2[illegible]-0	1.17[illegible]-0	1.135-0	1.133-0	1.105-0	1.[illegible]-0	1.149-0	1.053-0	1.034-0	1.018-0	1.002-0	9.871-1
4	1.240-0	1.21[illegible]-0	1.192-0	1.149-0	1.221-0	1.114-0	1.091-0	1.058-0	1.066-0	1.049-0	1.023-0	1.009-0

V	VV 12	13	14	15	16	17	18	19	20	21	22	23
0	9.[illegible]3-1	9.[illegible]-1	8.806-1	8.464-1	7.[illegible]73-1	2.[illegible]72-0	1.144-0	1.055-0	1.009-0	9.670-1	9.182-1	8.557-1
1	9.218-1	9.[illegible]-1	8.828-1	8.612-1	8.302-1	7.545-1	9.516-1	1.221-0	1.062-0	1.[illegible]-0	9.904-1	9.684-1
2	9.446-1	9.307-1	9.137-1	8.870-1	8.540-1	8.173-1	7.259-1	9.878-1	1.244-0	1.073-0	1.019-0	9.923-1
3	9.716-1	9.[illegible]-1	9.381-1	9.144-1	8.959-1	8.[illegible]-1	8.181-1	7.193-1	1.995-1	1.436-0	1.102-0	1.024-0
4	9.927-1	9.775-1	9.617-1	9.446-1	9.257-1	9.[illegible]-1	8.7[illegible]-1	8.335-1	7.537-1	4.[illegible]-1	1.976-0	1.162-0

Table III

R-CENTROIDS FOR (NO EPSILON (1/2))

VV / V	0	1	2	3	4	5	6	7	8	9	10	11
0	1.139-[illegible]	1.[illegible]87-[illegible]	1.096-0	1.044-0	1.030-0	1.015-0	9.949-1	9.852-1	9.731-1	9.602-1	9.469-1	9.327-1
1	1.136-[illegible]	1.114-[illegible]	1.159-0	1.102-0	1.055-0	1.037-0	1.022-0	1.005-0	9.909-1	9.773-1	9.642-1	9.517-1
2	1.156-[illegible]	1.194-[illegible]	1.119-0	1.082-0	1.072-0	1.055-0	1.043-0	1.028-0	1.011-0	9.961-1	9.826-1	9.698-1
3	1.134-[illegible]	1.178-[illegible]	1.140-0	1.131-0	1.112-0	1.076-0	1.012-0	1.054-0	1.033-0	1.017-0	1.002-0	9.882-1
4	1.264-[illegible]	1.208-[illegible]	1.182-0	1.152-0	1.080-0	1.115-0	1.086-0	1.052-0	8.797-1	1.044-0	1.024-0	1.008-0
5	1.267-[illegible]	1.231-[illegible]	1.211-0	1.167-0	1.162-0	1.129-0	1.158-0	1.097-0	1.072-0	1.049-0	1.179-0	1.133-0
6	1.312-[illegible]	1.274-[illegible]	1.244-0	1.218-0	1.193-0	1.172-0	1.144-0	1.086-0	1.115-0	1.094-0	1.061-0	1.038-0
7	1.341-[illegible]	1.314-[illegible]	1.278-0	1.251-0	1.215-0	1.201-0	1.182-0	1.158-0	1.126-0	1.102-0	1.100-0	1.073-0

VV / V	12	13	14	15	16	17	18	19	20	21	22	23
0	9.172-1	9.[illegible]15-1	9.338-1	9.829-1	8.859-1	8.944-1	8.994-1	8.730-1	8.643-1	1.106-0	1.050-0	1.032-0
1	9.385-1	9.279-1	9.157-1	9.032-1	8.848-1	8.699-1	8.411-1	7.853-1	6.145-1	2.853-0	1.143-0	1.028-0
2	9.574-1	9.452-1	9.328-1	9.138-1	9.054-1	8.887-1	8.532-1	8.021-1	7.928-1	6.697-1	8.263-1	1.153-0
3	9.7[illegible]-1	9.628-1	9.497-1	9.371-1	9.243-1	9.[illegible]05-1	8.348-1	8.754-1	8.479-1	7.995-1	6.566-1	3.104-0
4	9.936-1	9.808-1	9.675-1	9.550-1	9.424-1	9.295-1	9.159-1	9.016-1	8.859-1	8.514-1	7.945-1	6.128-1
5	1.[illegible]19-1	1.[illegible]01-0	9.861-1	9.732-1	9.609-1	9.484-1	9.352-1	9.207-1	9.043-1	8.842-1	8.553-1	8.009-1
6	1.[illegible]91-1	1.[illegible]24-0	1.018-0	9.884-1	9.785-1	9.664-1	9.540-1	9.413-1	9.271-1	9.103-1	8.849-1	8.591-1
7	1.[illegible]61-1	1.[illegible]25-0	1.033-0	1.[illegible]15-0	1.031-0	9.873-1	9.734-1	9.[illegible]88-1	9.466-1	9.334-1	9.193-1	8.989-1

Table II2

R-CENTROIDS FOR (NO EPSILON (3/2))

V \ VV	0	1	2	3	4	5	6	7	8	9	10	11
0	1.1[illegible]-0	1.0[illegible]-0	1.064-0	1.050-0	1.033-0	1.017-0	1.003-0	9.891-1	9.741-1	9.600-1	9.479-1	9.365-1
1	1.136-0	1.11[illegible]-0	0.453-1	1.077-0	1.056-0	1.039-0	1.023-0	1.01[illegible]-0	9.935-1	9.819-1	9.671-1	9.543-1
2	1.155-0	1.15[illegible]-0	1.119-0	1.093-0	1.052-0	1.067-0	1.045-0	1.028-0	1.013-0	9.987-1	9.853-1	9.723-1
3	1.198-0	1.17[illegible]-0	1.140-0	1.138-0	1.103-0	1.078-0	1.059-0	1.037-0	1.035-0	1.019-0	1.004-0	9.905-1
4	1.253-0	1.20[illegible]-0	1.183-0	1.152-0	1.096-0	1.114-0	1.097-0	1.084-0	1.019-0	1.045-0	1.026-0	1.010-0
5	1.259-0	1.239-0	1.210-0	1.173-0	1.152-0	1.131-0	1.152-0	1.090-0	1.074-0	1.052-0	9.238-1	1.035-0
6	1.303-0	1.274-0	1.243-0	1.214-0	1.192-0	1.173-0	1.145-0	1.111-0	1.119-0	1.096-0	1.063-0	1.042-0
7	1.325-0	1.303-0	1.277-0	1.244-0	1.212-0	1.201-0	1.206-0	1.157-0	1.129-0	1.392-0	1.103-0	1.075-0

V \ VV	12	13	14	15	16	17	18	19	20	21	22	23
0	9.264-1	9.171-1	9.068-1	8.924-1	8.683-1	8.220-1	7.031-1	1.020-0	1.551-0	1.132-0	1.008-0	9.361-1
1	9.4[illegible]-1	9.29[illegible]-1	9.173-1	9.043-1	8.913-1	8.745-1	8.494-1	8.008-1	6.444-1	2.857-0	1.140-0	1.034-0
2	9.545-1	9.47[illegible]-1	9.345-1	9.219-1	9.089-1	8.944-1	8.765-1	8.519-1	8.036-1	6.590-1	3.465-0	1.142-0
3	9.775-1	9.649-1	9.524-1	9.394-1	9.268-1	9.132-1	8.977-1	8.757-1	8.520-1	8.042-1	6.667-1	4.331-0
4	9.951-1	9.828-1	9.703-1	9.578-1	9.452-1	9.319-1	9.178-1	9.022-1	8.832-1	8.562-1	8.074-1	6.625-1
5	1.018-0	1.006-0	9.847-1	9.757-1	9.633-1	9.510-1	9.379-1	9.235-1	9.074-1	8.879-1	8.606-1	8.115-1
6	1.035-0	1.023-0	1.010-0	9.959-1	9.822-1	9.690-1	9.565-1	9.441-1	9.305-1	9.142-1	8.934-1	8.641-1
7	1.053-0	1.038-0	1.024-0	1.010-0	1.003-0	9.961-1	9.754-1	9.629-1	9.496-1	9.363-1	9.215-1	9.024-1

Table 113

Q-CENTROIDS FOR (NO BETA PRIME (1/2))

V \ VV	1	2	3	4	5	6	7	8	9	10	11
0	1.222-1	1.245-1	1.270-1	1.296-1	1.321-1	1.348-1	1.376-0	1.404-0	1.433-0	1.464-0	1.499-0	1.529-0
1	1.207-1	1.231-1	1.254-0	1.278-1	1.311-1	1.332-1	1.358-0	1.385-1	1.413-0	1.443-0	1.473-0	1.505-0
2	1.192-1	1.215-1	1.230-0	1.260-0	1.298-1	1.311-1	1.415-0	1.389-1	1.395-0	1.423-0	1.452-0	1.483-0
3	1.178-1	1.201-1	1.228-0	1.249-1	1.269-1	1.302-1	1.323-0	1.346-0	1.469-0	1.416-1	1.433-0	1.462-0
4	1.204-1	1.181-1	1.211-0	1.233-1	1.265-1	1.282-1	1.301-0	1.327-0	1.359-0	1.391-0	1.433-0	1.444-0
5	1.191-1	1.171-1	1.198-0	1.212-1	1.245-1	1.264-1	1.290-0	1.315-0	1.331-0	1.371-0	1.394-0	1.416-0

V \ VV	12	13	14	15	16	17	18	19	20	21	22	23
0	1.555-1	1.583-1	2.049-0	1.483-0	1.334-0	1.348-1	1.365-0	1.382-0	1.438-0	1.365-0	1.293-0	1.406-0
1	1.542-1	1.573-1	1.607-1	1.607-0	1.617-0	1.219-1	1.340-0	1.421-0	1.396-0	1.379-1	1.344-0	1.359-0
2	1.510-1	1.555-1	1.541-0	1.603-0	1.664-1	1.819-0	1.997-0	1.535-1	1.542-0	1.365-0	1.515-0	1.479-0
3	1.493-1	1.532-1	1.597-0	1.591-1	1.629-1	1.581-0	1.736-0	1.751-0	1.672-0	1.531-0	1.437-0	1.424-0
4	1.472-1	1.502-1	1.534-0	1.554-1	1.613-0	1.540-0	1.549-0	1.731-1	1.711-0	1.752-0	3.534-0	1.275-0
5	1.459-1	1.443-1	1.513-0	1.544-0	1.579-1	1.514-0	1.656-0	1.692-0	1.731-0	1.745-0	1.424-0	1.325-0

Table II4

R-CENTROIDS FOR (NO BETA PRIME (3/2))

V	VV	1	2	3	4	5	6	7	8	9	10	11
.	1.2[illegible]	1.247-0	1.272-0	1.297-0	1.323-0	1.349-0	1.377-0	1.405-0	1.436-0	1.465-0	1.495-0	1.531-0
1	1.2[illegible]	1.231-0	1.255-0	1.277-0	1.311-0	1.333-0	1.359-0	1.387-0	1.415-0	1.444-0	1.474-0	1.507-0
2	1.192-0	1.215-0	1.236-0	1.257-0	1.289-0	1.312-0	1.337-0	1.363-0	1.396-0	1.424-0	1.454-0	1.485-0
3	1.178-0	1.202-0	1.229-0	1.251-0	1.269-0	1.303-0	1.324-0	1.348-0	1.412-0	1.404-0	1.435-0	1.464-0
4	1.154-0	1.181-0	1.212-0	1.234-0	1.264-0	1.283-0	1.302-0	1.337-0	1.359-0	1.392-0	1.439-0	1.446-0
5	1.121-0	1.171-0	1.198-0	1.199-0	1.246-0	1.264-0	1.297-0	1.316-0	1.339-0	1.372-0	1.396-0	1.416-0

V	VV 12	13	14	15	16	17	18	19	20	21	22	23
.	1.636-0	1.659-0	1.477-0	1.547-0	1.295-0	1.514-0	1.375-0	1.675-0	1.393-0	1.203-0	1.396-0	1.324-0
1	1.545-0	1.592-0	1.603-0	1.563-0	1.945-0	1.237-0	1.326-0	1.429-0	1.334-0	1.585-0	1.421-0	5.771-1
2	1.517-0	1.551-0	1.587-0	1.618-0	1.637-0	1.783-0	5.474-0	1.494-0	1.527-0	1.279-0	1.328-0	1.397-0
3	1.494-0	1.525-0	1.560-0	1.595-0	1.630-0	1.665-0	1.741-0	2.091-0	1.588-0	1.547-0	9.705-1	1.253-0
4	1.474-0	1.504-0	1.536-0	1.578-0	1.605-0	1.641-0	1.696-0	1.751-0	1.758-0	1.640-0	1.607-0	1.391-0
5	1.451-0	1.483-0	1.515-0	1.545-0	1.590-0	1.615-0	1.653-0	1.695-0	1.733-0	1.739-0	1.755-0	7.977-0

Table 115

R-CENTROIDS FOR (NO GAMMA PRIME)

V \ VV	0	1	2	3	4	5	6	7	8	9	10	11
0	1.1[illegible]	1.0[illegible]	1.067-0	1.044-0	1.031-0	1.014-0	9.979-1	9.934-1	9.672-1	9.524-1	9.341-1	9.247-1
1	1.1[illegible]	1.11[illegible]	1.136-0	1.076-0	1.055-0	1.037-0	1.020-0	1.004-0	9.832-1	9.743-1	9.589-1	9.463-1
2	1.1[illegible]	1.15[illegible]	1.120-0	1.096-0	1.081-0	1.065-0	1.044-0	1.027-0	1.011-0	9.954-1	9.817-1	9.674-1
3	1.1[illegible]	1.17[illegible]	1.141-0	1.13[illegible]	1.104-0	1.081-0	1.056-0	1.054-0	1.034-0	1.017-0	1.002-0	9.841-1
4	1.22[illegible]	1.20[illegible]	1.165-0	1.15[illegible]	1.135-0	1.113-0	1.090-0	1.087-0	9.743-1	1.045-0	1.025-0	1.009-0
5	1.2[illegible]	1.23[illegible]	1.211-0	1.175-0	1.157-0	1.136-0	1.129-0	1.098-0	1.076-0	1.053-0	3.410-0	1.035-0

V \ VV	12	13	14	15	16	17	18	19	20	21	22	23
0	9.127-1	9.03[illegible]-1	8.988-1	9.002-1	9.068-1	9.151-1	9.157-1	9.041-1	7.8[illegible]-1	1.302-0	1.173-0	1.072-0
1	9.338-1	9.23[illegible]-1	9.153-1	9.091-1	9.029-1	8.936-1	8.771-1	8.472-1	7.951-1	6.587-1	1.124-0	1.029-0
2	9.544-1	9.422-1	9.303-1	9.187-1	9.074-1	8.966-1	8.851-1	8.749-1	8.606-1	8.399-1	8.066-1	7.475-1
3	9.7[illegible]1-1	9.60[illegible]-1	9.477-1	9.356-1	9.240-1	9.125-1	9.012-1	8.899-1	8.799-1	8.679-1	8.550-1	8.365-1
4	9.9[illegible]2-1	9.[illegible]-1	9.672-1	9.541-1	9.416-1	9.299-1	9.189-1	9.081-1	8.959-1	8.847-1	8.716-1	8.574-1
5	1.0[illegible]-0	2.0[illegible]-0	9.865-1	9.738-1	9.612-1	9.486-1	9.363-1	9.245-1	9.134-1	9.028-1	8.922-1	8.809-1

Table 116 R-CENTROIDS FOR (NO FEAST 1)

VV V	0	1	2	3	4	5
0	1.066-0	1.024-0	9.313-1	9.5[illegible]7-1	1.175-0	1.039-0
1	3.927-0	1.075-0	9.916-1	9.051-1	4.702-1	1.114-0
2	1.162-0	5.024-0	1.033-0	9.943-1	9.979-1	9.426-1
3	9.140-1	1.230-0	1.191-0	1.091-0	3.[illegible]56-0	8.150-1
4	1.196-0	1.823-1	1.359-0	1.310-0	1.1[illegible]0-0	2.941-1
5	1.035-0	1.094-0	1.129-0	1.591-0	1.[illegible]09-0	1.110-0
6	9.532-1	9.467-1	1.049-0	2.155-0	2.179-0	1.330-0
7	9.570-1	9.608-1	9.224-1	1.135-0	3.[illegible]82-0	8.520-1

Table 117 R-CENTROIDS FOR (NO FEAST 2)

VV V	0	1	2	3	4	5
0	1.068-0	1.683-0	1.[illegible]73-0	9.352-1	1.124-0	1.038-0
1	4.938-1	1.076-0	1.[illegible]67-0	1.037-0	1.[illegible]93-0	1.087-0
2	1.291-0	5.297-1	1.034-0	1.072-0	1.173-0	1.246-0
3	1.[illegible]34-0	5.136-[illegible]	3.041-1	1.[illegible]92-0	1.[illegible]20-0	1.127-0
4	1.134-0	1.259-0	1.419-1	3.625-1	1.1[illegible]0-0	1.957-0
5	1.[illegible]54-0	1.039-0	3.2[illegible]3-0	1.307-1	3.[illegible]06-1	1.109-0

Table 118

R-CENTROIDS FOR (NO EAST HEMI)

VV / V	0	1	2	3	4	5	6	7
0	1.[illegible]	1.[illegible]	1.236-	1.1[illegible]	1.[illegible]	1.[illegible]	2.1[illegible]	1.[illegible]
1	[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.125-0	1.[illegible]	1.[illegible]
2	[illegible]	[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	[illegible]
3	1.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	1.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	1.[illegible]	3.284-1	[illegible]	[illegible]	9.668-1	1.11[illegible]	[illegible]	9.461-1

Table 119

R-CENTROIDS FOR (NO L-M)

VV / V	0	1	2	3	4	5	6	7	8	9	10	11
0	1.2[illegible]	1.2[illegible]	1.236-0	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.452-0	1.[illegible]	1.[illegible]
1	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
2	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
3	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
4	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
5	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
6	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
7	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]

VV / V	12	13	14	15	16	17	18	19	20	21	22	23
0	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
1	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
2	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
3	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
4	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
5	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
6	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]
7	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]	1.[illegible]

Table 120

R-CENTROIDS FOR (D(2) S-R)

VV / V	0	1	2	3	4	5	6	7	8	9	10	11
0	1.374-0	1.384-0	1.404-0	1.419-0	1.435-0	1.450-0	1.466-0	1.483-0	1.500-0	1.517-0	1.534-0	1.553-0
1	1.364-0	1.382-0	1.397-0	1.412-0	1.427-0	1.443-0	1.458-0	1.474-0	1.491-0	1.507-0	1.525-0	1.542-0
2	1.362-0	1.371-0	1.390-0	1.405-0	1.420-0	1.435-0	1.451-0	1.466-0	1.482-0	1.498-0	1.515-0	1.530-0
3	1.356-0	1.371-0	1.384-0	1.399-0	1.413-0	1.428-0	1.443-0	1.459-0	1.474-0	1.490-0	1.503-0	1.537-0
4	1.351-0	1.364-0	1.378-0	1.393-0	1.407-0	1.422-0	1.437-0	1.451-0	1.466-0	1.481-0	1.509-0	1.514-0
5	1.345-0	1.359-0	1.373-0	1.387-0	1.401-0	1.415-0	1.430-0	1.444-0	1.458-0	1.495-0	1.494-0	1.509-0
6	1.340-0	1.354-0	1.367-0	1.381-0	1.395-0	1.410-0	1.424-0	1.438-0	1.439-0	1.473-0	1.486-0	1.499-0
7	1.335-0	1.348-0	1.362-0	1.375-0	1.390-0	1.404-0	1.418-0	1.430-0	1.454-0	1.465-0	1.478-0	1.485-0
8	1.331-0	1.344-0	1.358-0	1.371-0	1.385-0	1.399-0	1.412-0	1.424-0	1.445-0	1.458-0	1.471-0	1.493-0
9	1.327-0	1.341-0	1.354-0	1.367-0	1.380-0	1.394-0	1.406-0	1.420-0	1.439-0	1.452-0	1.455-0	1.486-0
10	1.323-0	1.337-0	1.350-0	1.363-0	1.376-0	1.389-0	1.398-0	1.421-0	1.433-0	1.446-0	1.471-0	1.480-0
11	1.320-0	1.333-0	1.346-0	1.359-0	1.372-0	1.385-0	2.142-0	1.416-0	1.428-0	1.438-0	1.462-0	1.474-0
12	1.317-0	1.330-0	1.343-0	1.356-0	1.369-0	1.381-0	1.404-0	1.412-0	1.424-0	1.393-0	1.456-0	1.469-0
13	1.315-0	1.326-0	1.341-0	1.353-0	1.366-0	1.377-0	1.398-0	1.408-0	1.420-0	1.446-0	1.452-0	1.464-0
14	1.312-0	1.325-0	1.338-0	1.351-0	1.364-0	1.373-0	1.394-0	1.405-0	1.416-0	1.439-0	1.449-0	1.460-0
15	1.311-0	1.324-0	1.336-0	1.349-0	1.362-0	1.367-0	1.392-0	1.403-0	1.412-0	1.435-0	1.446-0	1.454-0
16	1.309-0	1.322-0	1.335-0	1.348-0	1.360-0	1.357-0	1.390-0	1.401-0	1.407-0	1.432-0	1.444-0	1.443-0
17	1.308-0	1.321-0	1.334-0	1.347-0	1.359-0	1.312-0	1.388-0	1.399-0	1.400-0	1.431-0	1.442-0	1.327-0
18	1.307-0	1.320-0	1.333-0	1.346-0	1.358-0	1.441-0	1.387-0	1.398-0	1.396-0	1.429-0	1.440-0	1.487-0
19	1.307-0	1.319-0	1.332-0	1.345-0	1.357-0	1.399-0	1.386-0	1.397-0	1.340-0	1.428-0	1.439-0	1.472-0
20	1.306-0	1.319-0	1.332-0	1.344-0	1.356-0	1.390-0	1.385-0	1.397-0	2.023-0	1.428-0	1.438-0	1.467-0

Table 120 (cont'd)

(D(2) S-2)

V	VV 12	13	14	15	16	17	18	19	20	21	22	23
0	1.572-	1.591-	1.612-0	1.634-0	1.657-0	1.681-0	1.7.4-0	1.739-0	1.755-0	1.783-0	1.810-0	1.835-0
1	1.533-	1.575-	1.424-0	1.627-0	1.646-0	1.668-0	1.691-0	1.715-0	1.740-0	1.765-0	1.788-0	1.829-0
2	1.493-	1.537-	1.592-0	1.61 -0	1.629-0	1.644-0	1.665-0	1.717-0	1.727-0	1.751-0	1.777-0	1.804-0
3	1.545-	1.58 -	1.577-0	1.598-0	1.628-0	1.644-0	1.664-0	1.685-0	1.682-0	1.741-0	1.765-0	1.791-0
4	1.533-	1.544-	1.634-0	1.594-0	1.618-0	1.627-0	9.950-1	1.679-0	1.699-0	1.720-0	1.736-0	1.794-0
5	1.522-0	1.577-0	1.565-0	1.58 -0	1.593-0	1.633-0	1.643-0	1.662-0	1.678-0	1.714-0	1.733-0	1.753-0
6	1.342-0	1.533-0	1.553-0	1.594-0	1.611-0	1.612-0	1.628-0	1.647-0	1.678-0	1.697-0	1.714-0	1.765-0
7	1.516-0	1.524-0	1.540-0	1.577-0	1.584-0	1.598-0	1.716-0	1.645-0	1.663-0	1.675-0	1.711-0	1.733-0
8	1.536-0	1.514-0	1.631-0	1.553-0	1.572-0	1.535-0	1.617-0	1.632-0	1.631-0	1.679-0	1.696-0	1.706-0
9	1.489-0	1.504-0	1.538-0	1.544-0	1.556-0	1.592-0	1.605-0	1.611-0	1.653-0	1.667-0	1.681-0	1.715-0
10	1.482-0	1.534-0	1.528-0	1.539-0	1.532-0	1.580-0	1.592-0	1.632-0	1.639-0	1.653-0	1.646-0	1.699-0
11	1.483-0	1.511-0	1.521-0	1.523-0	1.550-0	1.571-0	1.537-0	1.614-0	1.629-0	1.694-0	1.673-0	1.687-0
12	1.492-0	1.503-0	1.514-0	1.567-0	1.552-0	1.552-0	1.533-0	1.605-0	1.611-0	1.655-0	1.665-0	1.656-0
13	1.481-0	1.494-0	1.507-0	1.534-0	1.546-0	1.544-0	1.546-0	1.595-0	1.675-0	1.642-0	1.656-0	1.687-0
14	1.483-0	1.494-0	1.495-0	1.53 -0	1.54 -0	1.525-0	1.579-0	1.588-0	1.626-0	1.635-0	1.642-0	1.677-0
15	1.479-0	1.491-0	1.375-0	1.52o-0	1.535-0	1.571-0	1.574-0	1.574-0	1.617-0	1.629-0	1.647-0	1.671-0
16	1.476-0	1.487-0	1.528-0	1.522-0	1.530-0	1.563-0	1.573-0	1.587-0	1.611-0	1.623-0	1.659-0	1.666-0
17	1.474-0	1.485-0	1.515-0	1.52 -0	1.524-0	1.553-0	1.557-0	1.637-0	1.608-0	1.617-0	1.652-0	1.663-0
18	1.472-0	1.483-0	1.510-0	1.518-0	1.516-0	1.535-0	1.554-0	1.609-0	1.605-0	1.611-0	1.649-0	1.661-0
19	1.471-0	1.482-0	1.508-0	1.516-0	1.509-0	1.533-0	1.552-0	1.607-0	1.602-0	1.607-0	1.646-0	1.659-0
20	1.470-0	1.481-0	1.506-0	1.515-0	1.487-0	1.532-0	1.550-0	1.596-0	1.601-0	1.546-0	1.645-0	1.657-0

APPENDIX IV

ADDITIONAL TABLES FOR BIRGE-HOPFIELD TABLES

The purpose of this appendix is to supplement data appearing in the main text of this technical report. New data has been published and these data have been incorporated into the tables of Franck-Condon factors included in this report. To minimize the changes to the main body of the report, these data are being included in this appendix.

The confusing and contradictory tangle of excited states for the very high energies in the nitrogen molecule has been unraveled (Refs. 41, 42, 43). Dressler (Ref. 41) reports that the former twenty states of excited nitrogen can be regrouped into three valence states and three Rydberg states. The three valence states are the $b^1\pi_u$, $b'^1\Sigma_u^+$, and d'. It will be noted that the first two states are those associated with the Birge-Hopfield band systems which are pertinent to this report. The renumbering of the levels of these states has vastly increased the number of vibrational levels for the upper states of each of these systems. This necessitated recalculating the vibrational transition probabilities. The input data used to calculate the vibrational potential for the $b'^1\Sigma$ state was the deperturbed spectroscopic constants of Dressler. These data are listed in table 121. For the input data needed for the $b^1\pi$ state, the data given by Carroll and Collins was graphically smoothed and used. These smoothed data are listed in table 122. The potentials resulting from these data are listed in tables 123 and 124. The potentials were generated using program TURNGPT. The vibrational transition probabilities were calculated using program FRANKON. The Franck-Condon factors are listed in tables 60 and 61.

Table 121

SPECTROSCOPIC CONSTANTS FOR THE $N_2 b'^1\Sigma_u^+$ STATE

v	G_v	B_v
0	371.9	1.151
1	1112.0	1.143
2	1848.0	1.135
3	2580.0	1.127
4	3308.0	1.119
5	4031.0	1.111
6	4750.0	1.103
7	5464.0	1.095
8	6174.0	1.087
9	6879.0	1.079
10	7580.0	1.071
11	8276.0	1.063
12	8960.0	1.055
13	9632.0	1.047
14	10292.0	1.039
15	10940.0	1.031
16	11576.0	1.023
17	12200.0	1.015
18	12812.0	1.007
19	13412.0	0.999
20	14099.0	0.991

Table 122

POTENTIAL ENERGY FOR THE $N_2 b'^1\Sigma_u^+$ STATE

v	$V(cm^{-1})$	r_{min}	r_{max}	$V_{(ev)}$
0	371.9	1.3672	1.5282	0.0461
1	1112.0	1.3158	1.5953	0.1380
2	1848.0	1.2825	1.6443	0.2292
3	2580.0	1.2568	1.6859	0.3199
4	3308.0	1.2355	1.7231	0.4102
5	4031.0	1.2170	1.7576	0.4999
6	4750.0	1.2007	1.7899	0.5890
7	5464.0	1.1861	1.8207	0.6775
8	6174.0	1.1729	1.8501	0.7655
9	6879.0	1.1607	1.8786	0.8529
10	7580.0	1.1495	1.9061	0.9398
11	8276.0	1.1389	1.9333	1.0261
12	8960.0	1.1283	1.9612	1.1109
13	9632.0	1.1181	1.9889	1.1942
14	10292.0	1.1083	2.0167	1.2761
15	10940.0	1.0988	2.0445	1.3564
16	11576.0	1.0896	2.0723	1.4352
17	12200.0	1.0807	2.1001	1.5126
18	12812.0	1.0719	2.1283	1.5885
19	13412.0	1.0640	2.1552	1.6629
20	14099.0	1.0701	2.1504	1.7480

Table 123

POTENTIAL ENERGY FOR THE $N_2 b\,^1\pi_u$ STATE

v	V(cm^{-1})	r_{min}	r_{max}	V(ev)
0	313.2	1.2053	1.3819	0.0388
1	947.0	1.1553	1.4540	0.1174
2	1632.0	1.1288	1.5031	0.2024
3	2354.0	1.1090	1.5445	0.2918
4	3110.0	1.0969	1.5792	0.3856
5	3889.0	1.0859	1.6121	0.4822
6	4682.0	1.0765	1.6437	0.5805
7	5481.0	1.0687	1.6751	0.6794
8	6278.0	1.0616	1.7063	0.7784
9	7063.0	1.0550	1.7390	0.8757
10	7831.0	1.0490	1.7725	0.9708
11	8578.0	1.0432	1.8070	1.0635
12	9303.0	1.0382	1.8426	1.1533
13	10004.0	1.0337	1.8794	1.2403
14	10682.0	1.0298	1.9169	1.3243
15	11337.0	1.0263	1.9555	1.4055
16	11967.0	1.0231	1.9954	1.4836
17	12575.0	1.0206	2.0359	1.5590
18	13159.0	1.0182	2.0780	1.6314
19	13719.0	1.0162	2.1216	1.7009
20	14255.0	1.0150	2.1672	1.7673
21	14768.0	1.0147	2.2149	1.8309
22	15257.0	1.0135	2.2652	1.8915

Table 124

SPECTROSCOPIC CONSTANTS FOR THE $N_2 b\,^1\pi_u$ STATE

v	G_v	B_v
0	313.2	1.442
1	947.0	1.424
2	1632.0	1.400
3	2354.0	1.376
4	3110.0	1.359
5	3889.0	1.334
6	4682.0	1.313
7	5481.0	1.286
8	6278.0	1.263
9	7063.0	1.235
10	7831.0	1.208
11	8578.0	1.181
12	9303.0	1.150
13	10004.0	1.120
14	10682.0	1.089
15	11337.0	1.059
16	11967.0	1.028
17	12575.0	0.997
18	13159.0	0.966
19	13719.0	0.934
20	14255.0	0.898
21	14768.0	0.860
22	15257.0	0.819

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In the process of calculating opacities which are needed as input data for radiation transport problems, the absorption cross sections for various species has to be known. One factor in the cross section is the vibrational transition probability, called the Franck-Condon factor (FCF). This report presents input data needed to calculate these from Rydberg-Klein potentials as well as tables of Franck-Condon factors for species of atmospheric interest.

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	ROLE	WT	ROLE	WT	ROLE	WT
Vibrational transition probabilities						
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Vibrational potential						
Rydberg-Klein potential						
N_2						
O_2						
NO						
CO						
CN						
N_2^+						
O_2^+						
Photoionization Franck-Condon factors						
Computer program						